Vol. 12, No. 17
September 15, 1987

Energy Research Abstracts

Abstracts 34454-36227

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT INFORMATION ON ENERGY

To provide immediate and complete coverage of literature related to major Department programs, the Office of Scientific and Technical Information provides an on-line retrieval system, data bases, and current-awareness publications. The Energy Data Base (EDB), which contains all unclassified, unlimited energy and nuclear related information processed by OSTI since 1974, and the Nuclear Science Abstracts Data Base (NSA), which covers nuclear information from 1948 through June 1976, are available for machine searching using commercial on-line retrieval systems. All information in the publications listed below, plus additional backup information, is included in the EDB. Current information being added to the EDB is available for on-line searching via the OSTI Automated Retrieval System (OARS) accessible to DOE and contractors through the Integrated Technical Information System (ITIS).

The publications described below and access to ITIS/OARS are available to Department of Energy and contractor components from the Office of Scientific and Technical Information, U. S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831/Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

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A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize legislative, regulatory, and other legal aspects, as well as social, economic, and environmental impacts. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price is $63.00 for domestic (North America) or $78.75 for foreign (outside North America) subscribers; a single issue is $6.00 or $7.50, respectively.

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A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The annual subscription price for the 24 issues is $146.00 for domestic (North America) subscribers or $182.50 for foreign (outside North America) subscribers. A single issue is $14.00 or $17.50, respectively.

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A monthly listing of conferences, symposia, workshops, etc., pertaining to DOE's programmatic interests. *EM* is available on subscription (use PB87-901500) from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $70.00 for domestic subscribers and $140.00 for subscribers outside the North American continent; a single issue is $8.00 and $16.00, respectively.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $80.00 for domestic (North America) and $160.00 for foreign (outside North America) subscribers; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB87-901000.** Acid precipitation, including effects and possible control measures.

***Buildings Energy Technology (BET)*–PB87-900700.** Technology required for energy conservation in buildings of all types.

***Coal-Based Synfuels (CBS)*–PB87-901400.** Conversion of coal into gaseous or liquid fuels.

***Coal Combustion and Utilization (CCU)*–PB87-914400.** Coal combustion, including fluidized bed combustion, and direct utilization of coal for power generation, fuel cells, and MHD generators.

***Coal Preparation and Pollution Control (CPC)*–PB87-900800.** Coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB87-946600.** Photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Energy from Biomass (EFB)*–PB87-900600.** Biomass production, conversion, and utilization for energy.

***Geothermal Energy Technology (GET)*–PB87-914700.** Exploration, development, and utilization of geothermal resources.

***Heavy-Ion Reactions (HIR)*–PB87-900500.** Heavy-ion ($A > 4$) reactions.

***Laser Research (LAR)*–PB87-901100.** Laser research and development, excluding applications.

***Nuclear Fuel Cycle (NFC)*–PB87-913400.** Both front and back ends of the nuclear fuel cycle.

***Nuclear Reactor Safety (NRS)*–PB87-913500.** Accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB87-902900.** Management aspects of transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB87-901200.** Research and development of efficient and reliable solar thermal conversion systems.

***Transportation Energy Research (TER)*–PB87-900900.** Energy-efficient advanced automotive propulsion systems and transportation energy conservation.

***Unconventional Petroleum (UCP)*–PB87-901300.** Secondary and tertiary recovery of petroleum and oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information (OSTI) cooperates in the publication of international abstract journals with the following: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts;* and (3) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts.* In each case, the cognizant foreign agency provides the non-U. S. information to OSTI for inclusion in the Energy Data Base; in turn, OSTI provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from Bernan Associates UNIPUB, 10033-F King Highway, Lanham, MD 20706. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $355.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information on the conversion of biomass to energy. *Biomass Abstracts* is available free to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 60 IR pounds per year for participating countries and 90 IR pounds per year for nonparticipating countries. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to DOE components and contractors from OSTI. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 110 pounds sterling per year.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE OFFICE OF SCIENTIFIC AND TECHNICAL INFORMATION

The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, OSTI places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Although the literature of science is emphasized, coverage extends to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish the mission of furnishing centralized support for Departmental elements in managing their scientific and technical information, OSTI builds and maintains computerized data bases and disseminates information via computerized retrieval systems and announcement publications such as abstract journals, bibliographies, and bulletins. Direct access to OSTI's Energy Data Base (EDB) and Nuclear Science Abstracts Data Base (NSA) is available to the U. S. scientific community through commercial on-line retrieval systems. Access to these data bases from outside the United States is available only through formal exchange agreements. The current-year EDB records, DOE Research-In-Progress, and various other specialized DOE data bases are available to DOE offices and contractors and other government agencies through the OSTI Automated Retrieval System (OARS), which is a major component of the Integrated Technical Information System (ITIS). In addition to providing access to the OSTI on-line systems, ITIS serves as a gateway to other government and commercial systems and provides information merging for customized information products. The Office of Scientific and Technical Information has developed systems to record and communicate energy-related research-in-progress information, to track research report deliverables from DOE contractors, to test and make available DOE-funded computer software programs with scientific and management applications, and to produce special publications in support of DOE program offices. To manage DOE's technical information resources effectively, OSTI's program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $146.00 for domestic subscribers and $182.50 for foreign subscribers. A single issue costs $14.00 (domestic) or $17.50 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The GPO Stock Number is 061-000-00697-4 and the price is $142.00 for the Volume 11 indexes. The cumulative indexes are also available in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161.

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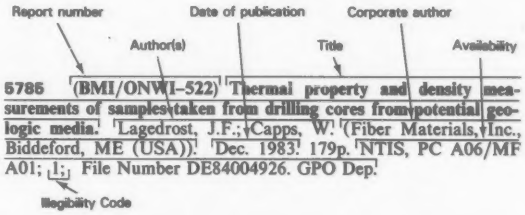
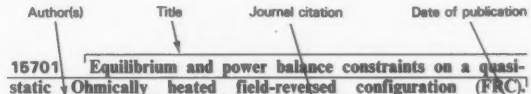
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI–522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; File Number DE84004926. GPO Dep.

Abstract: Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 **Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC).** McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion;* **23:** No. 10, 1319-1325 (Oct 1983).

Abstract: Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA).* Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

● Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI–522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

● Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
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● Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
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● Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI–522

● Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A file number–report number correlation is included for convenience.

BMI/ONWI–522 9:5785 NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70

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Commack, NY

Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 289 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R6 from NTIS for $9.50.

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REFER ALSO TO CITATION(S) 34477, 34479

34454 (CONF-860948—Summs.) Science and technology of fine coal processing: Final technical report for period July 21-October 15, 1986. Cobb, J.T. Jr. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Feb 1987. Contract FG22-86PC91405. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87008188.

From 3. annual Pittsburgh coal conference; Pittsburgh, PA, USA (8 Sep 1986).

This report contains short summaries of most of the papers given at the Third Annual Pittsburgh Coal Conference. (LTN)

34455 (DOE/PC/80517—T7) Improving the stability of coal slurries: Quarterly progress report for the period March 15, 1987-June 15, 1987. Fogler, H.S. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). 1987. Contract FG22-85PC80517. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010703.

Gum tragacanth, GT has been found to stabilize colloidal solutions. The stabilization effect with GT depends significantly on the pore size of the filter membrane. To investigate the dependence of the stabilization effect on the pore size of filter membrane, the Fourier transform infrared spectroscopy, FT-IR was employed. The FT-IR spectra showed that the chemical structure of GT was identical before and after the filtration. Next, the gel permeation chromatography was carried out, and it was found that the molecular weight distribution changes due to the filtration. Therefore, in order to study the effect of molecular weight on the stabilization effect, the amount of GT adsorbed, the zeta potential and steric layer thickness were measured. The results showed that the greater stabilization effect for the GT having the greater proportion of higher molecular weight fraction can be attributed to the greater steric layer thickness. 5 refs., 6 figs., 1 tab.

34456 Gas turbine fuel from low-rank coal. Maas, D.J.; Smit, F.J. New York, NY; American Institute of Chemical Engineers (1986). 74p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC21-84FC10623.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Five low-rank coals from the western United States were cleaned in a bench-scale heavy media separation procedure followed by acid leaching and hydrothermal processing. The objective of these cleaning steps was to determine the amenability of preparing gas turbine quality fuel from low-rank coal. The best candidate for scale-up was determined to be a Wyoming subbituminous coal from the Eagle Butte mine. Two hundred thirty kilograms of cleaned and micronized coal/water fuel were prepared in pilot-scale equipment to determine process parameters and fuel characteristics. After establishing operating conditions, two thousand kilograms of cleaned and micronized coal/water and powdered coal fuel were produced for testing in a pilot-scale gas turbine combustor. An economic analysis was completed for a commercial-scale plant designed to produce clean gas turbine fuel from low-rank coal using the most promising process steps identified from the bench- and pilot-scale studies.

34457 Heavy-liquid cycloning of fine-size coal. Maronde, C.P.; Killmeyer, R.P. New York, NY; American Institute of Chemical Engineers (1986). 32p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

The Coal Preparation Division of the Pittsburgh Energy Technology Center of the U.S. DOE recently conducted an in-house research study evaluating the use of heavy liquids in a cyclone to beneficiate fine-size coal. A closed-loop cyclone circuit was designed, constructed, and fitted with a 5-cm cyclone having a nominal 2-tph throughput. Testing incorporated a 30-test experimental matrix to evaluate the effects of feed inlet pressure, feed solids concentration, feed moisture content, and Aerosol OT-100 surfactant addition on separation efficiency when using Freon-113 as the separating liquid to beneficiate a 500 micron x O feed coal. Results of this work indicated that sharp separations can be achieved on fine-size coal using a Freon liquid as the separating medium, with ash and pyritic sulfur reductions of up to 63% and 78% respectively. Of the four operating parameters evaluated, feed moisture content had the greatest effect on the quality of separation. In particular, a 5% feed moisture produced the 7 best separations out of the 30 tests run.

0104 Processing

REFER ALSO TO CITATION(S) 34454, 34482, 34572, 35198, 35199, 35317, 35435, 35674

34458 (CONF-870659—1) Upgrading of condensibles from coal devolatilization. Mrochek, J.E.; Scott, C.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010899.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

This project has only been underway a very short time and initial efforts have been concerned with upgrading studies on the condensibles from the United Coal Company's mild gasification process. Ultimate analysis of the raw condensible product had been performed together with more detailed characterizations employing gas chromatography (GC) using flame ionization and nitrogen-specific detectors. In addition, gel permeation (GPC) and high-performance liquid chromatography (HPLC) using refractive index and ultraviolet detectors were performed to determine molecular weight distribution and aromatic and polar molecules in the heavy oil product. Initial upgrading studies were performed by solvent extraction using aqueous formic acid to investigate the removal of basic nitrogen-containing compounds. The results of this single-contact extraction are somewhat disappointing with only about 10% of the nitrogen-containing material being removed. An unexpected result was the nearly 41% removal of oxygen functionality shown for extraction with 25 v/v % formic acid. These extraction studies were then expanded to include multiple contacts and higher concentrations of formic acid (50 and 75 v/v %). The results demonstrate the need for higher concentrations of formic acid with nearly 50% removal using the highest concentration (75%) formic acid. Oxygen analyses are in progress and will be reported at the contractor's meeting in Morgantown. 11 refs., 3 tabs.

34459 **(DOE/FC/10601—2336) Kinetic model development for low-rank coal liquefaction: Final technical report for the period March 15, 1983-October 31, 1986.** Anthony, R.G.; Philip, C.V.; Moore, P. (Texas A and M Univ., College Station (USA). Kinetics, Catalysis, and Reaction Engineering Lab.). Feb 1987. Contract AC21-83FC10601. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87006475.

The primary lesson learned was that the recycle solvents produced after 25 to 40 passes from the UNDERC process development unit (PDU) were exceedingly poor hydrogen donors and thus poor liquefaction solvents. Water at supercritical conditions in the presence of hydrogen sulfide was a good liquefaction solvent. The distillate yields were greater than those obtained from some experiments using the recycle solvents. The new analytical techniques developed for the analysis of coal-derived liquids by using SEC-GC-MS provide detailed information on chemical species in coal-derived liquids in a reasonably short analysis time. The availability of the data in terms of molecular size distributions and true boiling point diagrams should be of exceptional value to the designer of separation equipment. The SEC-GC-MS technique was fully automated for collecting the fractions from the SEC and analyzing these fractions by GC-MS for identification of components and qualitative analysis of the individual SEC fractions. We are unaware of any other technique that yields as much information on the composition of a coal liquid, and that presents it in such a usable form for the design, simulation and operation of reactors and downstream separation equipment. A major problem in the development of the mathematical model for the upflow tubular liquefaction reactor was the lack of good physical property data, transport property data, and correlations for bubble column reactors. A second problem was the lack of data on the composition of the two phases along the axis of the reactor. New mathematical techniques were developed to minimize the amount of computer time required in the estimation of parameters for the model from the experimental data. The distribution of the liquid and gas phases and the composition of the hydrogen and carbon monoxide in each phase can be predicted by use of equations of state. 36 refs., 12 figs., 4 tabs.

34460 **(DOE/FC/10620—2353) Pulsating gasification of low rank coals: Quarterly technical progress report for the period October 1, 1986-December 31, 1986.** Powell, E.A.; Zinn, B.T. (Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering). Jan 1987. Contract AC21-84FC10620. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011045.

Parametric studies were continued during this quarter to investigate gasifiers with inlet reservoir devolatilization and 100% oxygen feed for gasifier lengths of 50 cm, 100 cm, and 200 cm. The effect of pulsations on the mass flow rates of product gases leaving the gasifier was investigated. Pulsations of moderate amplitude increased significantly the production rates of the fuel gases CO and H_2. The first test runs of the experimental gasifier with methane fuel were successfully completed. Later experimental runs were conducted in which pulsations were generated spontaneously.

34461 **(DOE/MC/21271—2341) Gas separation using ion exchange membranes: Final report.** Way, J.D.; Noble, R.D.; Powers, L.A. (National Bureau of Standards, Boulder, CO (USA). Center for Chemical Engineering; USDOE Morgantown Energy Technology Center, WV). May 1986. Contract AI21-84MC21271. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87006482.

The objectives of this project were twofold. The primary objective was to demonstrate the concept of using reactive ion exchange membranes (IEMs) containing organic amines for the separation of CO_2 and H_2S from coal gasification product gases. The potential advantage of this approach, known as facilitated transport, is to improve the selectivity of membrane separations without sacrificing high fluxes. A more fundamental objective was to investigate the mechanism of transport in ion exchange membranes. The facilitated transport of CO_2 and H_2S was studied using ion exchange membranes containing cations of ethylene diamine (EDA). Steady-state fluxes were measured for CO_2 and H_2S from single component gas streams, binary mixtures of CO_2 and H_2S with CH_4, CO_2/H_2S binary mixtures, and ternary mixtures containing $CO_2/H_2S/CH_4$. Fluxes were measured with and without EDA present as a function of feed gas composition. Diffusion coefficients were determined for H_2S, CO_2, and the EDA and gas complexes. A set of reaction and transport properties were collected from laboratory measurements and an extensive literature survey. The IEM separation factors compare very well with those for commercial membrane gas separation processes. Analytical models derived to predict the single component H_2S and CO_2 facilitation factors showed excellent agreement with experimental data. The importance of this project is that we have demonstrated experimentally that a reactive ion exchange membrane can be highly selective for CO_2 and H_2S over CH_4 and still have high fluxes. In addition, our understanding of the transport mechanisms involved has enabled us to simulate our experimental data theoretically, which is necessary for scaleup and design. 57 refs.

34462 **(DOE/MC/22012—2302) Containment control in four advanced coal conversion power generation systems: Technical issues and R and D needs: Final report.** DiBella, C.A.W.; Fillo, J.P.; Koraido, S.M. (KOH Systems, Inc., Rockville, MD (USA)). Mar 1987. Contract AC21-85MC22012. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87001084.

The objective of this study is to identify technical issues regarding gas stream contaminants and to develop suggested R and D programs to deal with the technicl issues in the following four advanced coal conversion systems for electric power generation: fixed-bed gasifier integrated combined-cycle system; fluidized-bed gasifier integrated combined-cycle system; direct coal fired turbine system; and pressurized fluidized-bed combustion/turbine system. All systems are pressurized and air-blown, use gas turbines with steam bottoming cycles, and use hot gas clean-up systems to achieve contaminant levels low enough to meet equipment protection considerations and environmental regulations. The contaminants included in this study fall into the following categories: sulfur compounds; nitrogen compounds; trace elements; particulates/solids; organic compounds, and alkali metals/halides. Although the focus of the study is principally on gas-stream contaminants, impact of contaminants on solid waste streams is considered to identify potential waste disposal issues. A total of 53 technical issues were identified, and an R an D need was developed for each issue. The issues were prioritized based on the impact on commercialization. Those issues representing significant impediments to commercialization were assigned high priority. It is recommended that current research activities be investigated in detail to determine if high priority technical issues are being addressed.

34463 **(DOE/MC/22109—2330) Use of cheap, sacrificial materials for valve trim in erosive slurry applications: Final report.** Hauserman, W.B.; Johnson, M.D. (North Dakota Univ., Grand Forks (USA). Energy Research Center; USDOE Morgantown Energy Technology Center, WV). Apr 1987. Contract AC21-85MC22109. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001095.

Laboratory tests were done to evaluate the feasibility of three novel concepts for high pressure let-down or control valves in abrasive/erosive slurry applications. All three assumed inexpensive, sacrificial materials to be eroded away and continuously replaced in service. A method was established for accelerated observation of erosion phenomena, using slurries of fine quartz dust, several times as hard as coals, in water at ambient temperature, acting on test fixtures of soft materials such as acrylic plastic. By this simulation method, erosion phenomena for novel slurry valve and pump designs can be studied with time and costs reduced by at least an order of magnitude. Of the design concepts studied, the Lathe Valve, used an expendable steel rod closing against the end of a thick-walled tube. Slow rotation of the rod delayed but failed to prevent valve failure by channeling of the plug or seat. With alternate valves in parallel, in a common housing, one can be reground, using the slurry as a grinding medium, while the other is controlling flow. The Mud Turbine involves closely opposing disks of expendable material, with flow spirally inward to an exit through one of the supporting shafts. Fluid friction railed to rotate the disks, as desired for process energy recovery, while seal and bearing problems were excessive. The most successful design was the Gravel Bucket, in which the slurry passes through a packed bed of narrowly sized, continuously replaceable crushed rock, with flow

controlled by varying the flow pattern through the bed. No plugging or channeling occurred.

34464 **(DOE/METC—87/0244) Underground coal gasification: Technology status report.** (USDOE Morgantown Energy Technology Center, WV). Oct 1986. 61p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87001004.

The US Department of Energy's Morgantown Energy Technology Center is conducting a program in underground coal gasification (UCG). The purpose of this program is to develop the technology for converting coal seams, in place, to a combustible gas that can be cleaned, treated, and upgraded for a variety of end uses, such as the production of chemicals, substitute natural gas, liquid fuels, and electrical power. Coal resources targeted for UCG processing are those coal seams that are unsuitable for recovery using current mining technology because of technical, environmental, health and safety, or economic factors. Conceptually, UCG processing is relatively simple and straightforward. Wells are drilled from the surface to provide access to the target coal seam. One well serves for injection of an oxidant, such as air or a mixture of oxygen and steam, into the seam, while another well serves as a production well for the gasification process gases. These two process wells are connected within the seam using one of several linking techniques to provide an open pathway for the flow of large quantities of gaseous products. Surface treatment of the product gas stream is similar to that for surface gasification processes. The Program is divided into two main technical areas or subprograms: (1) Process Technology, and (2) Process Monitoring, Control, and Environmental Impact Mitigation. The intent of this report is to present the research and accomplishments since 1983 by discussing the elements in these two subprograms that are inhibiting the commercialization of UCG: (1) site suitability, (2) process well linkage, (3) process control, and (4) environmental risks. 60 refs., 12 figs.

34465 **(DOE/METC—87/0252) Coal gasification: Technology status report.** (USDOE Morgantown Energy Technology Center, WV). Dec 1986. 42p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87001033.

The US Department of Energy's (DOE) Morgantown Energy Technology Center (METC) is currently sponsoring research and development (R & D) activities in surface coal gasification. The activities are primarily aimed at exploring and developing flexibility of the coal gasification technology. A wide range of technical needs could then be met for systems that are based on coal gasification. The systems include (1) integrated gasification combined cycle (IGCC) for electric power production, (2) production of synthesis gas, (3) production of value-added coproducts, and (4) production of industrial fuel gas. The R & D projects that are included in the Surface Coal Gasification Program cover a wide spectrum of technology development stages. These projects range from laboratory-scale investigations of a fundamental nature to the engineering-scale process development units (PDU's). In the area of laboratory-scale projects, fundamentals of gasification, gas purification, and gas separation are investigated to understand certain key parameters that will lead to gasification-based systems as the most desired energy alternatives. For the engineering-scale PDU's, novel process concepts are evaluated to obtain critical engineering and process data to translate the concepts into sound engineering designs. In addition, activities in the area of mathematical interpretation of coal gasification and associated gas separation and gas purification technologies are pursued to develop predictive capabilities and to conduct preliminary evaluations of various systems. This report provides comprehensive summaries of major accomplishments of the various projects in the Surface Coal Gasification Program. 5 refs., 18 figs., 4 tabs.

34466 **(DOE/PC/60036—15) Supercritical fluid extraction of coal: Final report.** Greenkorn, R.A.; Chao, K.C. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1987. Contract FG22-83PC60036. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87009856.

This is the final report on Supercritical Fluid Extraction of Coal. The objectives of the research for this project were: to investigate the beneficiation of coal by stripping with supercritical steam; to investigate recovery of light hydrocarbons by extraction with supercritical aromatic solvents and water and including nitrogen compounds and/or phenols We studied desulfurization of three midwestern coals stripping with supercritical steam. Desulfurization increased with increasing temperature and reaction time. Pressure and quantity of steam did not have a significant effect. We studied the reaction of steam with model compounds - dibenzothiophene, diphenyl sulfide and pyrites. We have studied the kinetics of reaction of model organic sulfur compounds dibenzothiophene, (DBT), dibenzyl sulfide (DBS) - with supercritical steam. The reaction order of DBT and steam is first order and the main product is biphenyl. DBS and steam are very reactive at temperatures as low at 400°C. DBS is converted to hydrogen sulfide, toluene, phenol and other as yet unidentified heavy compounds. The reaction of pyrites with steam follows a shrinking core model. The tar produced by coal extraction with supercritical steam has been characterized by correlation of G.C. retention time with weight, density and boiling point of pure known compounds. We constructed a supercritical chromatograph using ethane, propane, butane and carbon dioxide as carriers. Chromatographic data were obtained for phenanthrene and pyrene using supercritical propane as a carrier.

34467 **(DOE/PC/79863—T2) High-sulfur coal research at the SIUC Coal Technology Laboratory: Quarterly progress report, March 1, 1987-May 8, 1987.** (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). 1987. Contract FC22-87PC79863. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010427.

The theoretical study of the interaction of sulfur-containing species such as RSH, RR's, and H_2S with small metal clusters containing up to six metal atoms will be completed. These calculations will involve clusters of atoms of the metals iron, nickel, and molybdenum, and will use ab initio effective core potential techniques. Similar calculations will be carried out on these metal clusters with sulfur incorporated to study activation of the sulfur bound to a model metal surface. Finally, the interaction of this activated sulfur with incoming model reactants will be considered. Reactions of sulfur-containing substituted dibenzothiophenes with these transition metals will also be continued. The structures of the resulting complexes will be determined, with emphases on the nature and type of metal sulfur bonding and effect of the metal on the adjacent C-S bond lengths and bond energies. Greater attention will focus on the use of heteronuclear NMR and newer two-dimensional NMR experiments for the structure elucidation of metal-sulfur bonding types. It is hoped through these studies to increase our understanding of the role in-situ metal sulfides play in the coal desulfurization process and to improve prediction of new routes to coal desulfurization.

34468 **(DOE/PC/81544—T1) Novel mechanisms in aqueous liquefaction: Final report.** Mikita, M.A. (Colorado Univ., Denver (USA). Dept. of Chemistry). Feb 1987. Contract FG22-85PC81544. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87007378.

Three pairs of model compounds were proposed for use in a mechanistic study to evaluate the importance of possible ionic mechanisms when supercritical water is used as a medium for coal liquefaction. The syntheses of the Group I ethers: 2-benzyloxynaphthalene, 2-phenoxymethylnaphthalene, and 2-naphthylmethyl benzyl ether were completed using a modification of the Williamson ether synthesis which utilized sodium hydride as a base, and dimethylformamide solvent. Model compounds benzyl phenyl ether (BPE) and hydroquinone monobenzylether (HQMBE) were reacted in supercritcal water and deuterium oxide. The observed reactions with BPE were dominated by autooxidation reactions involving molecular oxygen unpurged from the reactor. Exchange was noted only with the product, phenol. The HQMBE reactions exhibited both homolysis and autooxidation pathways. No exchange was observed in any of the HQMBE products. These results do not support the concept of supercritical water being an important reactant under liquefaction conditions.

34469 **(DOE/PC/90009—2) Evaluation of direct methane conversion to higher hydrocarbons and oxygenates: Quarterly report for the period 1 January-31 March 1987.** Kuo, J.C.W. (Mobil Research and Development Corp., Paulsboro, NJ (USA)). Apr 1987. Contract AC22-86PC90009. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010959.

The preliminary evaluation of direct methane conversion processes has now been completed. Based on the results of this preliminary evaluation, two processes have been selected for more detailed evaluation. These are a "Partial Oxidation to Methanol" process and an "Oxidative Coupling to Ethylene" process. A detailed evaluation of these two processes was initiated in this quarter. Process flow schemes and associated computer programs were constructed and scoping process calculations were conducted for the partial oxidation to methanol process. 19 refs., 6 figs., 30 tabs.

34470 **(DOE/PC/90911—5) Reactivity of heteroatom-containing organics during liquefaction of subbituminous coal: Quarterly technical progress report, March 15, 1987-June 15, 1987.** Knudson, C.; Hawthorne, S. (North Dakota Univ., Grand Forks (USA). Energy Research Center). 1987. Contract FG22-86PC90911. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011270.

The objective of the described work is to provide a greater understanding of the role of heteroatoms in coal reactivity during low-severity liquefaction. The tasks performed in this report period focused mainly on reaction engineering. Products from the reactions will be extensively analyzed during the following report period. An autoclave liquefaction run was made to produce insoluble organic material (IOM) from Clovis Point coal for use in evaluating the stability of deuterium-labeled A04 solvent under liquefaction conditions. Based on the results of duplicate tubing bomb tests, the isotopic purity of the deuterium-labeled A04 appears to be stable under mild (350°C) conditions. Three other reaction conditions were tested during the same tubing bomb run. Test 2 was a reaction with coal and deuterium-labeled A04 solvent, test 3 was a reaction using A04 spiked with a set of 17 deuterium-laveled compounds, and test 4 used A04 spiked with 3 deuterium-labeled hydrogen donor species. All tests were duplicated, none of the 8 tubing bombs leaked, and all gave good recoveries.

34471 **(DOE/RL/01830—2279) Development of a solid absorption model and improved sorbent for solid supported molten salt hot gas cleanup process: Final report.** Lyke, S.E.; Butner, R.S.; Roberts, G.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1986. Contract AC06-76RL01830. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87001068.

Previous work at Pacific Northwest Laboratory (PNL) demonstrated that solid supported molten salt (SSMS) can remove H_2S, COS and HCl to less than 1 ppM from gasified coal to meet molten carbonate fuel cell feed specifications while allowing recovery of elemental sulfur. Stable performance through at least 16 absorption and regeneration cycles was also demonstrated. Although PNL's previous work demonstrated technical advantages of SSMS, low equilibrium capacity and mass transfer limitations made cost effectiveness questionable and difficult to evaluate. The objective of this project was to develop the basis for accurate evaluation of the potential system design advantages of SSMS cleanup and test the effect of increased surface area on performance. The scope of work included computer modeling and laboratory experimentation. A model of the SSMS absorption-regeneration process was developed in BASIC computer language and experiments performed to test the model and to demonstrate potential reductions in costs projected for commercial power plants. The computer model, based on two-film mass transfer theory, was verified by comparison with an analytical solution of a simplified case. It can accurately model results of previous experiments for H_2S and COS absorption and regeneration while predicting the behavior of HCl and metal chlorides in the absorber. High surface area sorbent was fabricated and tested in experiments which also tested a pressure-swing regeneration concept. Pressure-swing regeneration should allow reductions in sorbent requirements as well as equipment costs and energy consumption. The high surface concept and pressure-swing regeneration both proved effective. A 24% improvement in effective capacity over previously tested SSMS was demonstrated with a high surface area sorbent fabricated to PNL specifications by Katalco Corporation. 8 refs., 25 figs., 3 tabs.

34472 **(EPRI-AP—5203) Formulation of slurries for slurry-fed coal gasifiers: Final report.** Butcher, T.A.; Celebi, Y. (Brookhaven National Lab., Upton, NY (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. Contract AC02-76CH00016. 79p. NTIS, PC A05/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87010950.

A 100 MW integrated gasification/combined cycle generating plant was recently put into operation at the Cool Water generating station of Southern California Edison Co. Coal is fed into the gasifier as a coal-water slurry. This report describes an experimental study on the slurryability of candidate gasifier coals and slurry formulation options for use in systems of this type. The ten candidate coals studied ranged in equilibrium moisture from 1 to 13%. Coal characterization included standard analyses, relative hydrophilic/hydrophobic nature, surface area, density, surfactant adsorption, and leachable ions. A ranking was made of the relative slurryability of the coals under two cases, with and without an added surfactant. Slurry formulation studies included the effects of size distribution, acid leaching, additional physical cleaning (both gravity separation and froth flotation), selected anionic and nonionic surfactants, pH, and oxidation to simulate weathering. Slurry viscosity can be lowered by using optimized size distributions which are broader than those achieved in typical grinders. Acid leaching was found to be a very effective method of reducing slurry conductivity, which could promote dispersion of the particles. The effect on viscosity for the specific coals studied, however, was not significant. Similarly, additional physical cleaning was found to have no significant effect on coal equilibrium moisture or loadings on a weight basis. Significant loading increases could be achieved using low concentrations of surfactants alone. This is particularly true for the higher rank coals, which have lower additive demand, and have a greater viscosity reduction at the optimum additive concentration. 17 refs., 27 figs., 25 tabs.

34473 **(SAND—87-0270C) Causes of catalyst deactivation during quinoline hydrodenitrogenation.** Stohl, F.V. (Sandia National Labs., Albuquerque, NM (USA)). 30 Aug 1987. Contract AC04-76DP00789. 7p. (CONF-870802—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008523.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Previous studies of catalyst samples from the Wilsonville Advanced Coal Liquefaction R and D Facility have shown that the initial rapid catalyst deactivation was due to the buildup of carbonaceous deposits on the catalyst. Greater than 75% of the catalyst's hydrogenation (HYD) activity was lost as soon as coal processing began. Variations in the amount of carbonaceous deposits on the catalysts from several different Wilsonville runs, which used two different coals and three process configurations, were due to the process configuration but not the coal type. Results showed that the strong basic nitrogen compounds are most harmful to the catalyst. The current work involves determining the causes of deactivation due to hydrotreating pyridinic compounds. Quinoline was chosen as the model compound for this study because it represents a type of nitrogen compound present in coal-derived materials, and a hydrodenitrogenation (HDN) reaction network has been proposed for this compound. The initial work reported here on the causes of deactivation due to hydrogenating quinoline covers the impact of process conditions on deactivation and the determination of the effects of the reaction intermediates and products on deactivation. 9 refs., 2 figs., 3 tabs.

34474 **(SAND—87-0374C) The hydrogen transfer cycle for coal liquefaction: Process implications.** Stephens, H.P.; Kottenstette, R.J. (Sandia National Labs., Albuquerque, NM (USA)). 30 Aug 1987. Contract AC04-76DP00789. 8p. (CONF-870802—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008505.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

Direct liquefaction of coal involves the conversion of a hydrogen-poor solid to a liquid richer in hydrogen by a complex set

of bond ruptures and hydrogen transfer reactions. This study of the hydrogen transfer cycle for coal liquefaction suggests more effective ways to utilize hydrogen. The results of these experiments clearly demonstrate that an excellent coal liquefaction solvent can be produced by reaction of a coal-derived liquid with a H_2/CO/steam mixture at relatively low temperature and pressure. The resulting solvent contains a sufficient concentration of hydroaromatics to be used as the sole source of hydrogen for the liquefaction of coal. Applying these techniques for transfer of hydrogen to coal in a liquefaction process could provide several advantages: First, use of CO/H_2/steam mixtures, instead of purified hydrogen, for the hydrogenation of the solvent would eliminate the need for gas purification units. Second, operation of the solvent production reactor at a lower temperature and pressure would allow reduction of the wall thickness of the reactor vessel, thus reducing vessel cost. Third, the 650 to 770°F distillate cut used as a recycle solvent contains significant concentrations of the important three- and four-ring hydroaromatic donor precursors, but does not contain compounds that cause extensive catalyst deactivation. Finally, the requirement for gas-phase hydrogen and high pressure in the thermal liquefaction step would be eliminated. 6 refs., 4 figs., 2 tabs.

34475 **Catalytic cracking of tars from coal devolatilization.** Vasudevan, T.V.; Gokhale, A.J.; Mahalingam, R. (Dept. of Chemical Engineering, Washington State Univ., Pullman, WA 99164-2710). *Fuel Science and Technology International;* **5**: No. 1, 89-102(1987).

A set of runs were performed on the catalytic and thermal cracking of the tars present in the gasifier off-gas stream. The catalyst evaluated for tar cracking was a commercial cobalt-molybdenum catalyst, supported on γ-Al/sub 2/O/sub 3/(Katalco-477). It was observed that there was a decrease in the amount of tar obtained with the cracking unit on-line with the gasifier; the tars were cracked to gaseous products in the presence of catalyst. Furthermore, it appeared that higher ring structures were transformed to less heavier components; thus cracking could become beneficial in downstream processing of the gas stream coming out of a gasifier.

0105 By-products

REFER ALSO TO CITATION(S) 35859

0106 Properties

REFER ALSO TO CITATION(S) 34459, 34468, 34492, 35295

34476 **(DOE/PC/80522—T4) Metal arene complexes in coal structure determination: Quarterly report for the period March 1987-May 1987.** Woolsey, N.F. (North Dakota Univ., Grand Forks (USA). Dept. of Chemistry). Jun 1987. Contract FG22-85PC80522. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011338.

Carbon-carbon cleavage reactions have continued in the following areas: (1) Oxidation studies of hexamethylbenzenetricarbonylchromium anion with 2-(p-toluenesulfonyl)-3-phenyloxaziridine gave a low yield of pentaphenylbenzyl alcohol among other products. The yield is being optimized. (2) The addition of oxides (RN_3; R = EtOCO-, $PhSO_2$-, CF_3CO-) to the anion of a tetralicyclopentadienyliron(II) salt gave no carbon-carbon bond cleavage but instead N-R-1-tetrylamine derivatives. No conditions have been found which provide the desired cleavage. (3) Electrochemical oxidation studies of the iron anion in the presence of oxygen have been initiated to try to form the α-hydroperoxy derivatives. (4) Modification of a rhodium complex so that it may undergo carbon-carbon bond insertion has been completed but assessment of the results awaits completion of an x-ray crystal structure.

34477 **(DOE/PC/91272—T12) Characterization of mineral matter in pulverized coal by density profiling: Final report, March 1, 1986-February 28, 1987.** Jobling, J.L.; Crelling, J.C. (Southern Illinois Univ., Carbondale (USA). Dept. of Geology). Jun 1987. Contract FC22-86PC91272. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011026.

This study involved the careful analysis of the ash in coal and its removal in relationship to the petrology of the coal. The primary goal of this study was to demonstrate the use of density gradient centrifugation techniques to assess ash content and the distribution in maceral and lithotype components in micronized coal. An additional objective of the research was to utilize maceral density gradient separates to assess and characterize the ultimate cleanability of selected coals and to document attainable ash levels. The results indicate that the ash content of the various coal lithotypes are quite variable, although there is a tendency for the more vitrinite-rich lithotypes (vitrain and clarain) to have lower ash levels than the more inertinite-rich lithotypes (fusain and durain). It was common for the vitrain and clarain to have ash contents less than the whole coal values. Acid leaching (demineralization) of two micronized samples removed 80 and 87%, respectively, of the ash in the raw coal and centrifugation of these samples removed another 3 and 6%. Density gradient separation of non-demineralized samples yielded vitrinite with an ash content similar to that of the acid-demineralized raw coal. Also, the density gradient separation of the two acid-demineralized samples yielded vitrinites with ash contents of 0.15 and 0.26%, respectively. These values indicate ash reductions of 94.8% and 98.5%, respectively, and are believed to represent the greatest ash reduction possible at the present state-of-the-art. Finally, the inertinite maceral group had a significantly higher ash content. This suggests that coals with a high inertinite content may be inherently harder to clean than vitrinite-rich coals. 7 refs., 2 figs., 9 tabs.

34478 **(EPRI-EA—5148) Matrix isolation spectroscopy and the stability of polycyclic aromatics in coal ash: Final report.** Mamantov, G.; Wehry, R.L. (Tennessee Univ., Knoxville (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 210p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920458.

Matrix Isolation Spectroscopy (MIS) overcomes some limitations of conventional molecular fluorescence and infrared (IR) spectroscopies by producing spectra having perhaps 10 times narrower spectral peaks. Analyte molecules are prevented from interacting with each other (or any other foreign molecules) because they are surrounded by an inert solid matrix (e.g., N_2, Ar, Ne, or Kr) at temperatures <20 K. For IR applications, such matrices exhibit no spectral interferences (phonon peaks occur at $<85\ cm^{-1}$). When interfaced with conventional gas chromatography (GC), MIS can usually resolve coeluting compounds in complex organic mixtures and is particularly effective for analysis of polycyclic aromatic compounds (PAC). Often, pretreatment is not necessary if there are <10 different compounds in the sample. Owing to the low energy throughput of MIS, combining with dispersive IR is not an effective technique, whereas combining with Fourier-transform infrared (FTIR) and ultraviolet (uv)-visible fluorescence is. Also, matrix-isolation (MI) combinations with other methods, such as electron paramagnetic resonance (EPR), Raman spectroscopy, secondary ion mass spectrometry (SIMS), and photoacoustic spectroscopy (PAS), may be useful. Laser excitation provides a sensitivity of <1 mg/kg. Resolution can be improved using a monochromatic laser, a polarized excitation source and polarized emitted fluorescence, and measuring fluorescence decay time. A separate study showed that PAC are photochemically stabilized in coal ash because of its carbonaceous matter (pie-pie bonding and porosity effect). Nonphotochemical degradation (generally oxidation) occurs for specific PAC (especially those containing a benzylic C-atom, e.g., fluorene).

34479 **(IS-T—1300) Effect of surface oxidation on the properties and agglomeration characteristics of coal.** Druding, J.M. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010929.

Oxidation of Upper Freeport coal deleteriously affects the oil agglomeration process for the beneficiation of fine coal. In this process, fine coal is suspended in water and contacted with a small amount of oil or hydrocarbon-liquid such as n-heptane. The latter was used in the work reported here. The hydrophobic nature of the unoxidized coal surface leads to bridging of the coal particles by the oil or heptane, while the ash-forming minerals tend to be more hydrophilic and are not agglomerated. Subsequent recovery of the larger coal aggregates on sieves is then possible. Surface oxidation

by air in a laboratory oven at 150°C renders the coal surface more hydrophilic and reduces the recovery dramatically from near 100% for the unoxidized coal to as little as 20%. Surface oxidation leads to an increase in oxygen-containing functional groups, which seems to cause the increase in hydrophilicity. Analytical chemical techniques revealed increasing concentrations of both carboxyl and hydroxyl groups over increasing periods of oxidation; FTIR spectroscopy revealed similar trends with the augmentation of the peaks corresponding to the expected oxidative products associated with coal. Incorporation of the anionic surfactant sodium oleate rendered the oxidized coal surface less hydrophilic, leading to enhanced recovery. On the other hand, the cationic surfactant cetyl trimethyl ammonium bromide (CTAB) had little effect on oxidized coal recovery. 60 refs., 20 figs.

34480 **Analysis of trace elements in the new US geological Survey standard coal (CLB-1) and selected premium coal reference materials.** Palmer, C.A.; Crandell, W.B.; Evans, J.R.; Gillison, J.R.; Moore, R.; Sellers, G.A.; Skeen, C.J.; Winters, L.J. (Geological Survey, Reston, VA). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Carefully characterized coal standards are needed for trace-element analysis. Six newly available reference samples including five samples from the Premium Coal Sample Program at Argonne National Laboratories and one US Geological Survey coal (CLB-1) were analyzed in triplicate. A total of 70 elements were determined using instrumental neutron activation analysis, flame, cold vapor, and graphite furnace atomic absorption techniques, dc arc spectrography, X-ray fluorescence, and C-H-N elemental analysis. Recommended values were established by evaluating data from several analytical techniques whenever possible. Aliquots for each analysis were taken from the same bottle. Two additional bottles of CLB-1 were also analyzed in triplicate to determine sample homogeneity. The Premium Coals include bituminous and sub-bituminous coal samples from the Upper Freeport coal bed (Pennsylvania), Wyodak coal bed (Wyoming), Illinois No. 6 coal bed (Illinois), Pittsburgh No. 8 coal bed (Pennsylvania) and the Pocahontas No. 3 coal bed (Virginia). The US Geological Survey coal sample is from the Lower Bakerstown coal bed in Maryland. These six coal samples have ash yields (500°C) which range from 5 to 16%. Silicon concentrations range from 1 to 4%, aluminum concentrations from 0.4 to 2.5%, and iron concentration from 0.3 to 2.6%/ The concentrations of trace elements reported in this study range over more than an order of magnitude for most elements.

34481 **Kinetic studies of the carbochlorination of dispersed metal oxides in a molten salt reactor.** Dobbins, M.S.; Burnet, G. New York, NY; American Institute of Chemical Engineers (1986). 29p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract W-7405-ENG-82.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

The carbochlorination of alumina and of mixed oxides slurried in a stirred melt of NaCl-AlCl/sub 3/ using chlorine was investigated. Reaction rates and the reaction mechanism were determined at temperatures of 530 to 800°C by sampling the contents of the reactor during operation and by analyzing the off gases using a direct coupled gas chromatograph. The effects of carbon and oxide loading, salt composition and amount of agitation were studied. Alumina chlorination was significantly influenced by an interaction between carbon and chlorine. At temperatures below 650°C, alumina chlorination was kinetically controlled, while gas-liquid mass transfer was limiting at higher temperatures. Chlorination rates for the mixed oxides of Al, Si and Fe found in power plant pulverized coal ash were strongly influenced by the dissolution rate of the oxides.

0108 Waste Management

REFER ALSO TO CITATION(S) 34462, 34478, 35587, 35588

34482 **(DOE/FC/10297—2334) Anaerobic treatment of gasifier effluent: Final report.** Cross, W.H.; Pohland, F.G.; Chian, E.S.K.; Harper, S.R.; Lu, F.; Gao, H.; Saunders, F.M.; Havash, J.; Wang, E. (Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering). Dec 1986. Contract AC21-81FC10297. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87001099.

Studies have been conducted to determine the biological treatability of coal gasification effluent for removal of organic carbon and ammonia. The treatment system consisted of an anaerobic activated carbon filter for organic carbon removal followed by a single stage nitrification system followed by a biological denitrification reactor. Dilute (~10%) wastewater was successfully treated over an extended period of time. However, after extended operation (~ one year) inhibition of the biological system was encountered. This inhibition could be overcome by periodic replacement of a portion of the granular activated carbon contact media. Attempts to utilize the anaerobic system to treat solvent extracted ammonia stripped coal gasification effluent to remove substituted hydantoins was of limited success. Removals of 50% of the influent hydantoins were realized but only very small amounts of gas were produced. Apparently the primary removal mechanism was by adsorption on the granular activated carbon. Batch inhibition studies showed substituted pyridines as the primary inhibitory compounds in the raw wastewater. Carbon adsorption-solvent regeneration for hydantoin removal did not appear to be a viable treatment alternative due to low adsorption capacities and incomplete regeneration of the activated carbon. 37 refs., 63 figs., 23 tabs.

34483 **(DOE/PC/60797—15) Intermediates formed during supercritical desulfurization of coal: Fifteenth quarterly technical progress report, January 1, 1987 to March 31, 1987.** Muchmore, C.B.; Chen, J.W. (Southern Illinois Univ., Carbondale (USA). Dept. of Mechanical Engineering and Energy Processes). 1987. Contract FG22-83PC60797. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010480.

The process variables examined were solvent (methanol and ethanol), with and without nitric acid pretreatment for removal of pyritic sulfur, and with and without potassium hydroxide added (5% of the weight of coal charged). The coal and solvent charges were held constant at 200 g each for all runs, and reaction time was one hour at a reaction temperature of 350°C. Previously, the coal employed for this study had been processed in the 300cc reactor system at 350 to 400°C for 30 minutes at 4200 psig, utilizing nitric acid pretreatment and the methanol/KOH system. The resulting solid product had a total sulfur content of 0.44%, representing a 70.5% reduction in sulfur over alcohol reaction, and 83.4% overall.

34484 **(PB—87-167458/XAB) Method for locating abandoned mines. Rept. of Investigations/1986.** Burdick, R.G.; Snyder, L.E.; Kimbrough, W.F. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1986. 34p. (BM-RI—9050). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-600217.

The problems presented by old mine workings affect both present-day mining and land development. An automated method of locating these old mines from the surface using electrical-resistivity techniques was developed earlier under a Bureau of Mines contract. Subsequent Bureau research has refined the techniques and expanded the area of study to a variety of geologic provinces. During this research, six mining areas in the United States were investigated with the Bureau's automated resistivity method. The report describes the mining areas involved and the results of the resistivity investigations, which showed a high rate of success in detecting old mines.

34485 **(PB—87-167706/XAB) Pilot testing of sodium thiosulfate.** Chang, J.C.S.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). 1986. 11p. NTIS, PC A02/MF A01.

Pub. in Environmental Progress, Vol. 5, No. 4, 225-233(Nov 1986).

The article gives results of pilot-plant tests to evaluate sodium thiosulfate as an oxidation-inhibition additive in five lime/limestone slurry flue-gas desulfurization processes. It was found that the oxidation rate of absorbed SO_2 was reduced by more than 50% in the presence of 100-200 ppm of thiosulfate ion in the scrubbing slurry. Calcium sulfate dihydrate (gypsum) scaling was eliminated and the unsaturated (with respect to gypsum) operation mode was maintained by the addition of sodium thiosulfate. Other benefits of sodium thiosulfate addition observed at the pilot plant included improvement in solids dewatering properties for limestone processes and improvement in SO_2 removal efficiency for magnesium-enhanced lime/limestone processes.

34486 **(PB—87-167714/XAB) Gypsum crystallization for limestone FGD (flue-gas desulfurization).** Chang, J.C.S.; Brna, T.G. (Acurex Corp., Research Triangle Park, NC (USA)). 1986. 7p. NTIS, PC A02/MF A01.

Pub. in Chemical Engineering Progress, Vol. 82, No. 11, 51-56(Nov 1986).

This paper gives results of pilot plant tests using a double draw-off crystallizer as the hold tank to improve the gypsum dewatering properties of a forced-oxidation limestone flue gas desulfurization process. A hydroclone was used as the size-classification device for solids separation and fines removal. Compared with a mixed tank crystallizer, the double draw-off crystallizer resulted in a 45% reduction in free moisture within the filter and a 58% increase in filtration rate.

34487 **(PB—87-167730/XAB) Thiosulfate as an oxidation inhibitor in flue-gas desulfurization processes: a review of R and D results.** Rochelle, G.T.; Owens, D.R.; Chang, J.C.S.; Brna, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1986. 11p. (EPA—600/J-86/277). NTIS, PC A02/MF A01.

Pub. in Air Pollution Control Association Jnl., Vol. 36, 1138-1146(1986).

The article describes the pilot-plant testing of sodium thiosulfate ($Na_2S_2O_3$) as an oxidation inhibitor in flue gas desulfurization by lime and limestone slurry scrubbing with and without MgO and adipic acid additives. The effectiveness of thiosulfate is proportional to the inhibitor product, defined as the product of thiosulfate concentration (M), calcium concentration (M), and the moles of SO_2 absorbed per hour per liter of hold tank volume. Gypsum saturation was less than 100% and scaling was eliminated when the inhibitor product exceeded 0.3×10^{-6} M^3 hr. Thiosulfate was relatively more effective in systems with chlorides and less effective in systems promoted by MgO. An inhibitor product greater than 10^{-6} M^3/hr significantly enhanced dewatering of solids from limestone scrubbing. SO_2 removal and/or limestone utilization were increased in systems that started with less than 10 mM dissolved calcium.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 34485, 34486, 34487, 34512, 34686, 35106, 35108, 35856

34488 **(PB—87-162889/XAB) Diesel-exhaust/coal-dust exposure study: characterization of selected vapor-phase organic emissions.** Lunsford, R.A.; Okenfuss, J.R.; Shulman, S.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 28 Feb 1984. 36p. NTIS, PC A03/MF A01.

In efforts to characterize the atmospheres present in animal exposure chambers, samples of the air were taken during coal dust and diesel exhaust inhalation studies. No detectable quantities of phenol, cresol, and the xylenols were found in the exposure chambers. Formaldehyde and acetaldehyde were present at slightly under 40 parts per billion (ppb) concentration levels. Other aldehydes present in the chambers were at much lower concentrations, about 6ppb. Formaldehyde was the only aldehyde consistently present in the nondiesel chambers, at 7ppb. It is suggested that the water scrubber on the diesel engine used in the study might have moderated the concentrations of water-soluble pollutants, such as aldehydes and phenols. A combination of analytical results suggests that formaldehyde, acetaldehyde, and acrolein were the major aldehydes present in the diesel exhaust, each at levels less than 100ppb.

34489 **(PB—87-163135/XAB) Crystalline silica and silicon analyses from the NIOSH/EPA coal/diesel study using x-ray fluorescence spectrometry and x-ray powder diffraction.** Palassis, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 1982. 14p. NTIS, PC A02/MF A01.

The concentrations of crystalline silica and total silicon were determined for 12 animal exposure chambers used in the coal/diesel study. Chambers were sampled monthly or bimonthly. Of the 12 chambers, three contained clean air, three contained coal dust, three contained diesel exhaust, and three contained mixtures of the dust and exhaust. Analysis for silica and silicon content in bulk coal dust samples was also made. All three clean air chambers showed no detectable silica concentration. Some silicon was detected in coal chambers, but never exceeding 35microg/cu m. Silicon concentrations in the coal/diesel chambers were near the detection limit of 11microg/cu m. Diesel chambers gave silicon concentrations below the detectable limit. The bulk-coal dust sample contained an average of 3.1% crystalline silica and 2.2% silicon concentrations.

34490 **(PB—87-163226/XAB) Trace-metals analyses of coal and diesel airborne particulate.** Millson, M.M.; Hull, R.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 1982. 45p. NTIS, PC A03/MF A01.

Samples of air were removed from exposure chambers used in animal experiments in order to analyze the atmosphere used in the coal and diesel emissions study to determine the presence of seventeen selected trace metals. These elements included aluminum, arsenic, beryllium, cadmium, calcium, cobalt, chromium, copper, iron, lead, magnesium, manganese, nickel, sodium, titanium, vanadium, and zinc. Arsenic, beryllium, cadmium, chromium and vanadium were below the 0.5 microgram metal/cubic meter of air limit of quantitation in each chamber. Only occasionally were cobalt, copper, manganese, nickel and lead found. The remaining elements were found often in some of the chambers. Even though these elements were present in measurable quantities, these levels were still far below the OSHA limits.

34491 **(PB—87-166682/XAB) Design of a graphite-element drop-tube reactor system for study of SO_2 removal by injected limestone sorbents.** Gullett, B.K.; Snow, G.C.; Blom, J.A.; Kirchgessner, D.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1986. 8p. (EPA—600/J-86/273). NTIS, PC A02/MF A01.

Pub. in Review of Scientific Instruments, Vol. 57, No. 10, 2599-2604(Oct 1986).

The article describes the design and operation of a graphite-element drop-tube reactor system for a study of the fundamental mechanisms and reaction rates of SO_2 removal by high-temperature injection of limestone-based sorbents. The reactor system is designed for laminar flow in an environment that allows for control of reaction temperature, sorbent-particle residence time, and atmosphere composition. The sorbent-injection system allows variable feed rates to as low as 1 mg/min. for particles as small as 1 micrometer in diameter. The water-cooled sorbent collection system arrests the high-temperature reaction upon capture and allows analysis of the sorbent's efficiency of SO_2 capture and in-situ particle-size distribution. The results presented show the reactivity of different types of sorbents at varying conditions of system operation.

34492 **(PB—87-167698/XAB) Influence of fuel composition on nitric oxide formation in mass-burning stokers.** Starley, G.P.; Overmoe, B.J.; Pershing, D.W.; Martin, G.B. (Utah Univ., Salt Lake City (USA). Dept. of Chemical Engineering). 1986. 7p. NTIS, PC A02/MF A01.

Pub. in FUEL, Vol. 65, 1047-1050(Aug 1986).

The article gives results of testing seven coals of varying rank in an experimental mass-burning simulation to assess general

nitric oxide (NO) emission characteristics. The fuels were compared to ascertain a relationship between NO emissions, fuel nitrogen content, nitrogen volatility, and firing conditions. Considerable variability in exhaust NO emissions was observed between coal types, even for coals of common rank fired under similar thermal and stoichiometric conditions. Fuel nitrogen conversion to NO was not singularly dependent on inherent nitrogen content or volatility. A correlation was developed to estimate NO emissions based on both coal nitrogen content and char nitrogen fraction for combustion conditions typical of mass-burning stokers.

0110 Reserves And Exploration

34493 (NP—7752440, pp 30-31) **Clay stones of the Baernbach coal basin.** Kolmer, H. Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The dirt-band sediment cores drilled from the Baernbach coal basin which is a subtrough to the Koeflach-Voitsberg lignite region, were examined mineralogically, sediment-petrographically and technologically. The drilled cores are composed of quartz and - to lesser moieties - of fieldspar, sericite/illite, chlorite and kaolinite at varying quantities.

34494 **(PB—87-168639/XAB) Stratigraphy and stratigraphical palaeontology of Westphalian B and C in the Central Coalfield of Scotland.** Forsyth, I.H.; Brand, P.J. (British Geological Survey, Edinburgh). 1986. 25p. NTIS, PC PC E04/MF E04.

Also pub. as Report of the British Geological Survey, Vol. 18, No. 4(1986).

The report describes the Middle Coal Measures (Westphalian B) in the Central Coalfield of Scotland that are represented by 150 to 200 m of coal-bearing cyclic sediments that increase in thickness eastwards and the Upper Coal Measures that belong mostly to Westphalian C. Lithologically the Upper Coal Measures resemble the upper part of the Middle Coal Measures but have mostly been reddened, with replacement of coal by limestone. The stratigraphical position of the Bothwell Bridge Marine Band was established and the band was shown to extend from the Hamilton district to Glasgow.

0120 Mining

REFER ALSO TO CITATION(S) 34514

34495 **(PB—87-167433/XAB) Firing-delay characterisitics of instantaneous and seismic detonators. Rept. of Investigations/1986.** Bajpayee, T.S.; Mainiero, R.J.; Hay, J.E. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 17p. (BM-RI—9054). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600119.

The report describes an evaluation by the Bureau of Mines of the firing delay and interval of commercially available instantaneous and seismic detonators considered for use with nonincendive sheathed explosive rock-breaker charges. Detonators manufactured by three domestic companies were evaluated. Time measurements were based on the principle of detecting ionization at the detonation front. High-resolution digital oscilloscopes and twisted-pair ionization probes were integral parts of the experimental setup. Firing delays and firing intervals were measured using 3 different test procedures.

34496 **(PB—87-167474/XAB) Thickening fine-coal-refuse slurry for rapid dewatering and enhanced safety. Rept. of Investigations.** Stewart, B.M.; Backer, R.R.; Busch, R.A. (Bureau of Mines, Spokane, WA (USA). Spokane Research Center). 1986. 19p. (BM-RI—9057). NTIS, PC A02/MF A01.

The Bureau of Mines report presents results from experimental studies on wood crib fires in an intermediate-scale fire tunnel. Gas concentrations, smoke-particle characteristics, heat-release rates, and ventilation rates were determined. These measurements form a data base for wood, which can be used with previous analyses for coal and future studies of other mine combustibles, to comprehend the potential hazards of these materials in underground-mine fires. A knowledge of the combustion products emitted from these materials will benefit fire detection and control. Results show the changes in burning rate and heat release rate produced by different crib configurations and ventilation rates. Also included are the effects that the burning rate has on smoke characteristics and gas production.

34497 **(PB—87-167524/XAB) Surface subsidence over longwall panels in the western United States: monitoring program and final results at the Price River Coal Co. No. 3 mine, Utah. Information Circular/1986.** Fejes, A.J. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1986. 28p. (BM-IC—9099). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-600182.

As part of its mine-subsidence research program, the Bureau of Mines and the American Electric Power Co. cooperated on a study, conducted at the Price River Coal Co. No. 3 Mine, directed toward developing the capability to estimate the surface subsidence resulting from longwall mining in a geologic, topographic, and mining environment common to coal fields in the Western United States. Subsidence was monitored at the No. 3 Mine over two adjacent longwall panels. The subsidence study area was reduced when the two planned panels were reduced in length because of equipment failure and a mine fire. Subsidence was measured for 21 months. Subsidence continued for 6 months after mining had been completed. A maximum of 2.2 ft. of subsidence occurred over the two longwall panels mined at an overburden depth ranging from 800 to 1500 ft.

34498 **(PB—87-167573/XAB) Dust controls to improve quality of longwall intake air. Information Circular/1986.** Organiscak, J.A.; Jankowski, R.A.; Kelly, J.S. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 15p. (BM-IC—9114). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600261.

The Bureau of Mines has recently completed a program to identify and evaluate various methods that address control of dust generated by the longwall mining face. Dust-control techniques were identified and tested at a number of longwall-mining sections located in diverse geological conditions across the United States. Dust controls investigated include (1) methods that eliminate the sources of intake dust contamination-homotropal ventilation, (2) methods to limit the amount of respirable dust released into the intake airstream-improved water application and the use of curtains and enclosures, and (3) methods to clean the contaminated air prior to delivery to the mining face-scrubber systems. Usually, they can be implemented at a low cost and can be very effective. The report describes each technique and its application and presents the resulting conclusions.

34499 **(PB—87-167631/XAB) Development of protective operator compartment for thin-seam mobile bridge carrier. Information Circular.** Kwitowski, A.J.; Gunderman, R.J. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 34p. (BM-IC—9093). NTIS, PC A03/MF A01.

The Bureau of Mines report summarizes the development of a protective operator compartment for a new-generation thinseam mobile bridge carrier. The developed compartment is commercially available and is currently employed on approximately 15 bridge carriers used in the mining industry. The design of the compartment, which employed human factors engineering and small- and full-scale mockup models, is fully described. Details of the compartment's fabrication, evaluation, and demonstration in a commercial low-seam coal mine are also provided.

34500 **(PB—87-167649/XAB) Strata interactions in multiple-seam mining - two case studies in Pennsylvania. Rept. of Investigations.** Chekan, G.J.; Matetic, R.J.; Galek, J.A. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 25p. (BM-RI—9056). NTIS, PC A02/MF A01.

The Bureau of Mines, in an effort to improve planning and development in coal mining, is investigating strata interactions associated with mining of multiple coalbeds. Two common interactions that occur between adjacent coalbeds are subsidence and pillar load transfer. The study described involves underground observations and measurements conducted at two Pennsylvania mines, each affected by one of these interactions. Underground measurements and results obtained from both mine sites correlate with theoretical and photoelastic multiple-seam models, and eventually these field data will serve to refine model accuracy. Further study of multiple-seam interaction mechanisms will lead to improved mine planning, increased resource conservation, and a safer working environment.

34501 **(PB—87-171294/XAB) Demonstration of MINOS coal clearance system at Barnes and Tucker Lancashire No. 20 mine. Open file report.** Beaumont, G.S. (National Coal Board, Burton-on-Trent (UK). Mining Research and Development Establishment). Aug 1986. 361p. NTIS, PC A16/MF A01.

The report presents a demonstration in the use of a surface-based centralized computer control system for the remote monitoring and control of underground conveyors in a U.S. coal mine. The system selected for demonstration was the Dynalink Micro MINOS system manufactured by Hawker Siddeley Dynamics Engineering Ltd. The site selected was Barnes and Tucker Lancashire No. 20 Mine located near Carrolltown, Cambria County, Pennsylvania. The system concept and operating and application software were designed and developed by the British National Coal Board. The report describes the selection of the site, specification of the system requirements, and the commissioning, operation, and evaluation of the system under typical U.S. mine operating conditions. Experience with the system, based primarily on the system reliability and performance of conveyor control, was favorable. Mine management personnel felt that the system had successfully achieved its objectives and were keen to expand monitoring and control to other activities.

34502 **(PB—87-171567/XAB) Evaluation of bearing plates installed on full-column resin-grouted bolts. Report of Investigations/1986.** Tadolini, S.C.; Ulrich, B.F. (Bureau of Mines, Denver, CO (USA). Denver Research Center). 1986. 19p. (BM-RI—9044). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 86-600185.

The Bureau of Mines conducted field investigations in two underground mines to determine the actual loads to which bearing plates were subjected when installed in conjunction with full-column resin-grouted bolts and the roof movements generated by the applied loads. Measured loads indicate that the bearing plate is an integral part of the support system. Vertical displacement gauges installed to monitor roof displacements in the test sites show that the highest degrees of loading occur in conjunction with the largest amounts of movement.

34503 **(PB—87-179008/XAB) In-situ strength characteristics of coal-mine floor strata in Illinois. Open file report, 15 October 1985-22 September 1986.** Chugh, Y.P. (Southern Illinois Univ., Carbondale (USA). Dept. of Mining Engineering). Sep 1986. 161p. NTIS, PC A08/MF A01.

The report presents data on bearing capacity and in-place shear-strength characteristics of immediate floor strata. Plate load tests were conducted under as-mined and saturated and/or wet conditions. Borehole shear tests were conducted to determine cohesive strength, angle of internal friction, and failure envelope for floor strata at different depths. An attempt was made to correlate the above data with laboratory determined strength deformation characteristics and engineering index properties of floor strata from ongoing studies. The results indicate the nature of floor strata at the two mines to be very similar. Statistically significant correlations were observed for two sets of variables: (1) ultimate bearing capacity and deformation modulus, (2) natural moisture content of floor in the 0- to 12-inch depth range below the coal seam and ultimate bearing capacity. Attempts to correlate ultimate bearing capacity and cohesive strength of immediate floor strata determined from borehole tests and confined compression tests were generally unsuccessful.

34504 **(PB—87-181855/XAB) Control of respirable quartz dust on continuous-mining sections. Open File report, September 1983-December 1986.** Taylor, L.D.; Thakur, P.C.; Riester, J.B. (Conoco, Inc., Morgantown, WV (USA)). Dec 1986. 68p. NTIS, PC A04/MF A01.

The report describes research to identify the sources and distribution of quartz dust in underground coal mines and to evaluate various types of bits. The study found that the main source of respirable quartz dust was the continuous miner when cutting rock material. Other activities in the section, such as roof bolting operations, normally did not contribute significant amounts of quartz dust. One forward-attack and nine conical bits were tested in the laboratory to determine the amount of dust generated and the energy requirement for each bit. The laboratory tests indicated that slender bits with narrow tip angles generated less dust with less energy than larger bits with wide tip angles. The forward-attack longwall bit also performed better than most of the other test bits. Tests conducted underground found that the smaller bits and the longwall bits were prone to wear, resulting in higher dust levels. The larger conical bits were not affected to the same degree. Underground power consumption measurements did not distinguish between the power required by different bits.

34505 **(PB—87-182978/XAB) Evaluation of the TEOM (tapered-element oscillating microbalance) dust monitor. Information Circular/1986.** Williams, K.L.; Vinson, R.P. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 23p. (BM-IC—9119). NTIS, PC A02/MF A01.

Library of Congress catalog card No. 86-600242.

The Bureau of Mines tested a prototype tapered-element oscillating microbalance (TEOM) dust monitor for measuring respirable coal-mine dust. Tests were performed to determine variability, drift, the effect of humidity, placement of collection filter, and element orientation during analysis, and comparability with gravimetric measurements of respirable coal dust. Dust tests were performed in an aerosol chamber using coal dust. Measurements made by the TEOM dust monitor agreed to within 10% of simultaneous measurements by gravimetric personal samplers.

34506 **(PB—87-183828/XAB) Human factors contributing to groundfall accidents in underground coal mines: workers' views. Information Circular/1987.** Peters, R.H.; Wiehagen, W.J. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1987. 30p. (BM-IC—9127). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-600355.

This report presents findings from a Bureau of Mines study on barriers that may prevent miners from correcting and avoiding groundfall hazards. Such barriers stem from four basic types of problems: inability to recognize groundfall hazards; inability to correct groundfall hazards; lack of motivation to search for groundfall hazards; lack of motivation to correct groundfall hazards. The report also includes a summary of miners' responses concerning their recent experiences with groundfall accidents, along with industry-wide statistics on accidents and injuries caused by groundfalls in underground coal mines.

0130 Transport And Handling

34507 **(DOE/PC/90958—T2) Study of dense phase cohesive coal transport in plugs: Quarterly report, December-March 1987.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-86PC90958. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010483.

Existing methods of forming plug flows are classified into two types. The first one is using secondary air injection from place to place along the pipeline; the by-pass system by Lippert, the

added-gas system by Krambrock, and push system by Muller and Schroter. The other method is by supplying air or particles into the pipeline pulsating and intermittent; gas-pulse system by Lanchester. All the equipment to study the plug flow stability of coal in PVC pipe for the vertical mode has been completely installed. Currently, we are testing the plug stability in 2.0 inches ID pipe. The main study involves testing the influence of particle size and particle size distribution on the plug stability. -200 mesh and -325 mesh Pittsburgh coals were used for this purpose. Table 1 shows some results for -200 mesh Pittsburgh coal that have been obtained to date. The air was supplied slowly.

34508 **(EPRI-AP—5214) Pulverized coal in dense flow: Final report.** Lowry, W.E. (Mountain States Energy, Inc., Butte, MT (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 33p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920446.

Dense phase coal transport tests were conducted at the DOE Component Development and Integration Facility to evaluate transport system performance over a range of system pressures and pressure differentials. Resultant solid/gas mass ratios and transport system pressure drops were studied using Montana Rosebud coal pulverized to 50% passing a 200 mesh sieve. Mass flows up to 612 lbm/min were achieved with solid/gas mass ratios ranging from 59:1 to 339:1. Results indicated that within experimental error and considering natural variations in coal gas-filled void fraction, the solid/gas mass ratio in dense phase feed systems such as this can be predicted if the coal particle density, void fraction, and gas density in the injection vessel are known. Dominant system pressure drops occurred at the injection vessel, receiving vessel, and across a Coriolis meter. Line pressure drop per unit length was characterized with two line sizes as a function of flowrate. System pressure drops were strong functions of coal flowrate and appeared independent of total system pressure. Several coal mass flow measurement techniques are reviewed, and the viability of a potential, nonintrusive, cross-correlated density approach is demonstrated. 7 refs., 11 figs., 3 tabs.

34509 **(PB—87-169975/XAB) Water-quality characterization of an eastern coal slurry.** Cooper, C.D.; Dietz, J.D.; Flint, M.J.; Todd, M.R. (University of Central Florida, Orlando (USA). Coll. of Engineering). Mar 1987. 116p. NTIS, PC A06/MF A01.

Current and projected used of coal have resulted in several proposals for coal-slurry pipelines in the United States. A typical eastern coal has a greater sulfur content and a smaller percentage of alkaline minerals in the ash than a typical western coal. Thus, eastern coal slurries likely will yield different quality wastewaters from western coal slurries. An experimental program was conducted to characterize the wastewater resulting from a 50% eastern Kentucky coal slurry. Twenty-nine water-quality parameters were measured as a function of pumping time in the pilot-scale pipeline. Tests were conducted with and without a nitrite-based corrosion inhibitor added directly to the slurry. The treatability of the 10-day slurry wastewater was assessed using both lime and alum addition.

0140 Combustion

REFER ALSO TO CITATION(S) 34492, 34812, 35431, 35432

34510 **(DOE/FC/10627—2361) Surface adhesion of low rank coal ash: [Quarterly technical progress report]: October 1-December 31, 1986.** Austin, L.G.; Conn, R.E. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Feb 1987. Contract AC21-85FC10627. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011271.

Darco (TX) lignite was ion-exchanged with ammonium acetate. The amount of ASTM ash (dry basis) was reduced from 11.3 to 7.1 wt % after the lignite was ion-exchanged. The amount of exchangeable sodium and calcium were found to be 90% and 78%, respectively. The gas-fired drop tube furnace was used to produce deposits with raw and ion-exchanged Darco lignite on mild steel substrates at conditions similar to those producing utility boiler slagging. The hot zone temperature was held at 1500°C and the constrictor temperature was held at 1300°C for these tests. The estimated particle residence time within the hot zone was approximately one to two seconds. The sticking fraction of the Darco lignite ash was 0.45 for a 20 minute test duration and a feed rate of 0.35 g/minute. The resultant deposit was very fused at the top and had a high strength (>5.5 MPa). Increasing the oxygen partial pressure to 60% did not have a significant effect on deposit formation rate or strength for Darco lignite. The electrically-heated drop furnace was used to form deposits with raw and ion-exchanged Darco lignite on stainless steel substrates at conditions similar to those producing utility boiler convective fouling. The hot zone temperature and constrictor temperature were held at 1500°C and 1200°C, respectively. The estimated particle residence time within the hot zone was about 2.0 to 3.5 seconds. The gas velocity at the constrictor was held at 15 m/second. The sticking fraction of the Darco lignite ash was 0.42 for a 20 minute test period; the resultant deposit was strongly sintered at the top and had a moderate strength of 2 to 6 MPa.

34511 **(PB—87-173258/XAB) Direct reduction of hematite fines with coal in a fluidized bed.** van den Berg, J.C.; Dippenaar, R.J. (Council for Mineral Technology, Randburg (South Africa)). 17 Dec 1986. 25p. (MINTEK-M—288). NTIS, PC PC E03/MF E01.

A preliminary investigation was undertaken on the direct reduction of hematite fines in a single-stage fixed fluidized bed. Coal was combusted in situ as a means of supplying the heat and producing the reducing gas. It was found that the type of coal used had a significant effect on the behavior of the fluidized bed. With the reactor used and a selected type of coal, a reduction of 11,1% was obtained. Various fundamental principles underlying the process were investigated. On the basis, ways of improving the reduction are suggested.

34512 **(PB—87-178794/XAB) Comparison of an optical particle-size monitor and a cascade impactor for in-stack source testing.** Conner, W.D.; Knapp, K.T. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1985. 7p. (EPA—600/J-85/481). NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 19, No. 5, 458-462(May 1985).

Particle-size measurements by a prototype in-stack optical particle-size monitor are compared to concurrent particle-size measurements by an in-stack cascade impactor at three coal-fired fly-ash sources. The results indicate that the optical monitor and impactor size measurements defined similar particle size distributions between 0.2 and 20 micrometers. Particles smaller than 0.2 micrometers as expected, were not observed by the optical sizer. Particles larger than 20 micrometers were also not expected to be detectable but the optical instrument may have some sensitivity to the larger-size particles. Mean size measurements by the optical instrument were always larger than similar measurements by the impactor.

34513 **Coal-water slurry fueled diesel: Current research developments.** Stodolsky, F. (Argonne National Lab.). pp 1-15 of Coal liquid mixtures: The path to commercialization. Arlington, VA; Pasha Publications (1986). (CONF-860217—).

From Coal-liquid mixtures conference; Tampa, FL, USA (3 Feb 1986).

Over the years, there have been many attempts to burn coal in a compression-ignition (diesel) engine for power production. Recently, U.S. Department of Energy sponsored tests of finely micronized coal-water slurry fuel in a single cylinder slow-speed diesel test engine have shown combustion efficiency comparable to typical values when operating on No. 2 diesel fuel. In support of this program, an economic evaluation of a coal-fueled slow-speed cogeneration facility was made. This paper summarizes the economic evaluation and the engine test program and suggests areas of future research and development required to commercialize this potential coal-fueled cogeneration option.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 34972, 35003

34514 (DOE/EIA—M022) Coal supply and transportation model (CSTM): Model description. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Jun 1987. 122p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. File Number DE87011309.

This report is a technical description of the Coal Supply and Transportation Model (CSTM). Its purpose is to provide documentation of the CSTM model. The problem addressed is to meet a set of fixed demands for coal in demand regions by producing coal in supply regions and shipping it across a transportation network. The CSTM approaches the problem of supplying and transporting coal by seeking to reach an equilibrium of delivered prices for all sources of coal supplied to meet each demand. Demands are exogenous point demands, specified in total British thermal units (Btu) required in a demand region and sector. The formal conditions for equilibrium are that the delivered prices from each source of supply for a specific point demand be equal and that no delivered price can be lowered by shifting sources of supply or transportation routes. These conditions are formally equivalent to minimizing the total delivered cost of coal. The CSTM forecasts coal production and coal transportation patterns by combining a shortest-path algorithm with a heuristic procedure for shifting production and transportation flows until delivered coal prices are in equilibrium. The model provides annual forecasts of volumes and prices for coal production in each supply region and transportation on each route.

0160 Health And Safety

REFER ALSO TO CITATION(S) 34499, 34506, 35371

34515 (PB—87-167623/XAB) Bureau of Mines research into reducing materials-handling injuries. Information Circular. Unger, R.L.; Bobick, T.G. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). 1986. 29p. (BM-IC—9097). NTIS, PC A03/MF A01.

The Bureau of Mines entered into a cooperative agreement with an eastern Kentucky coal mining company to comprehensively redesign the flow of equipment and supplies throughout its underground mines. Activities such as handling daily supplies (concrete blocks, rock dust, and crossbeams) and handling or lifting the continuous-miner power cable were determined to be the most hazardous. Recommendations to the company included redesigned surface-storage areas to facilitate the use of forklift vehicles to load the underground supply cars. Designs were also developed for different mechanical-assist devices to help in unloading the supply cars underground and to handle equipment maintenance tasks underground. Additionally, the videotapes of the underground manual-handling tasks became the basis for simulating those activities in controlled laboratory conditions. This testing will contribute to developing guidelines for proper lifting techniques for low-seam coal mines.

02 PETROLEUM

0203 Drilling And Production

34516 (DOE/BC/10852—1, pp 20-26) **Decision time at US DOE on microbial enhanced oil recovery research.** Folstein, R.L. (Dept. of Energy, Bartlesville, OK). Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

In opening remarks at the conference, the US DOE director from Bartlesville, Oklahoma discussed EOR technologies and their potential for maintaining domestic oil production. US production averages 15 barrels/well/day compared to 268 barrels/well/day for the rest of the world. There are still some technical constraints to EOR technologies. Nearly 80 percent of EOR production is thermal; 18 percent is gas flooding, mostly carbon dioxide. As far as DOE-sponsored research on MEOR is concerned, it is time to decide whether progress made so far justifies moving the research into the mainstream of the DOE EOR program or whether it should be dropped.

34517 (DOE/BC/10852—1, pp 27-53) **Overview of microbial enhanced oil recovery research.** Swan, A.G. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The paper reviews research and field test results of microbial enhanced oil recovery and discusses the problems with the studies and the research still needed to be done. The depressed economics of the petroleum industry are also discussed. The cost of four EOR technologies and their efficiency in recovering residual oil is cited: steam drive, in-situ combustion, carbon dioxide flooding, and surfactant/polymer flooding. The biggest problem with field tests of MEOR is the use of unqualified wells.

34518 (DOE/BC/10852—1, pp 54-64) **Microbial enhanced oil recovery needed to help economy of oil-producing states.** Stenholm, C.W. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A discussion is presented on the economics of the petroleum industry, the potential of MEOR to help the economy of Texas and other oil-producing states, and the energy policy of the US. The price of oil could go as low as four dollars a barrel. Imports are forecast to increase which would have serious national security implications.

34519 (DOE/BC/10852—1, pp 72-78) **Geological and engineering evaluation of MEOR: formation evaluation.** Knapp, R.M. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The problems a reservoir engineer faces in the evaluation of a petroleum deposit for microbial EOR are discussed. The important properties needed to be determined are listed: residual oil saturation, permeability, porosity, pore throat size, and reservoir flooding properties. Even at a 10-acre spacing, a drill core can only observe about one millionth of the reservoir volume. If instead, a microbial treatment is to be a well stimulation treatment, evaluation becomes simpler, and this is also discussed.

34520 (DOE/BC/10852—1, pp 79-88) **Geological implications and their effect on the realization of MEOR.** Bubela, B. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The interrelationships among the geology and mineralogy, the reservoir fluids, and microbiology involved in microbial enhanced oil recovery are discussed. Research findings are described on permeability changes, dolomitization in a carbonate reservoir, clay mineral blockages, fatty acid production during MEOR, response of microorganisms to heavy metals, i.e., lead, copper, and zinc, and the effect of reservoir temperature and pressure on microorganisms.

34521 (DOE/BC/10852—1, pp 89-105) **Plugging and penetration of petroleum reservoir rock by microorganisms.** Updegraff, D.M. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

Research findings are discussed which describe what is known about the penetration and plugging of porous media by bacteria. It has been determined that pores of reservoir rock must be at least twice the diameter of the microorganism to avoid serious plugging problems. Several case histories are given to describe permeability decreases caused by bacteria contained in injection waters

and the penetration of living bacteria of various sizes and shapes through petroleum reservoir rocks in the presence and absence of liquid flow. The use of bacteria for selective plugging of strata is briefly described. 30 references.

34522 (DOE/BC/10852—1, pp 113-123) **Microorganisms and enhanced oil recovery.** Moses, V. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The presentation deals with the problems which must be solved before reservoir engineers can be expected to try microbial EOR technologies. These problems include communication between scientists who think in terms of controlled experiments and engineers who think in terms of practical end results and the need for computer modeling of the microbial processes. Three areas are discussed in which biological activity may be of value in oil production: well clean up or stimulation, selective plugging and profile improvement, and polymer or surfactant production by microorganisms emplaced underground.

34523 (DOE/BC/10852—1, pp 124-145, 147-151) **Research on microbiology of MEOR in Romania.** Lazar, I. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

Results are described from research in Romania from 1973-83 on microbiological aspects of the in-situ use of bacteria in petroleum recovery. The research programs discussed are: 1. microorganisms occurring in formation water of reservoirs, including those of interest for microbiological treatment; (2) reservoir conditions required for the microbiological method; (3) ecological sources rich in mesophilic bacteria with fermentation activity in media with formation water, crude oil, and molasses; (4) isolation and selection of bacteria adapted to reservoir conditions; (5) types of inoculum and preparation for well injection; (6) factors that influence the production of gases, acids, and solvents; (7) characteristics of the inoculum used for well injection; (8) technology of well injection with bacteria and nutrient support based on molasses; and (9) evaluation of bacteria in formation water and effects of microbiological treatment. The strengths and weaknesses of the MEOR method are summarized. 33 references, 11 tables.

34524 (DOE/BC/10852—1, pp 152-187) **Physiology and nutrition of potential MEOR bacteria, including the influence of certain reservoir minerals in continued viability and gas production.** Grula, M.M. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

Sodium chloride inhibition of the growth and gas production, mostly carbon dioxide, of Clostridia species is described. The effect of ferrous sulfate was also tested. It was found that Clostridia species inhibited the growth of sulfate-reducing bacteria which are considered undesirable in oil reservoirs. Also discussed are the effects of different kinds of molasses on gas production, the effects of the reservoir rock on gas production, and the production of surfactants and emulsifiers by Clostridia strains. 8 figures, 15 tables.

34525 (DOE/BC/10852—1, pp 188-213) **Spiculisporic acid produced by Pencillium spiculisporum 44.** Xiu-yuan, W. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The conditions suitable for the production of spiculisporic acid are described. This compound may prove important in enhanced oil recovery because of it surface active, antibiotic, and anti-corrosive properties, as well as it stability to higher temperatures and salinity. Results from the chemical and physical analyses of the product acid are given. Included are spectra from NMR and IR spectroscopy. Surface and interfacial tensions were also measured. 14 references, 10 figures, 5 tables.

34526 (DOE/BC/10852—1, pp 214-220) **Laboratory studies of mechanism of microbial oil release.** Yarbrough, H.F. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A series of tests are described to determine the separate and combined effects of gases and acids on tertiary oil release. Results show that MEOR depended upon the presence of carbonate and the production of acid. Gas production, whether from microbial fermentation or carbonate neutralization, had little or no effect. 3 tables.

34527 (DOE/BC/10852—1, pp 225-232) **Application of bacteria to the in-situ recovery of heavy oil.** Jack, T.R. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

In primary production of heavy oil, selective plugging of the water-producing zones would be advantageous. Research efforts beginning with the screening of effective microorganisms for plugging a unconsolidated sand reservoir are discussed. A set of organisms was found which produce polymer chunks about 400 microns in size. Absorption of the bacteria onto clay particles was a problem solved by using sacrificial agents. Areas where further work is needed are discussed.

34528 (DOE/BC/10852—1, pp 233-240) **Transport of bacteria in porous media.** Yen, T.F. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A discussion is presented on the problems involved in transporting bacteria far into reservoir rock. Absorption and flocculation of the bacteria occur. The zeta potential is also an important factor in the transport through porous media. Once bacteria are in place, Brownian movement and cell motility will cause migration within the reservoir. Conditions vary from reservoir to reservoir, so only experiments performed with rock and oil from the reservoir will give reliable results for that reservoir.

34529 (DOE/BC/10852—1, pp 241-246) **Scale-up of microbes for single well injection.** Zajic, J.E. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The discussion focusses on the steps to be taken when injecting a single oil well for MEOR without an added water flood. Values for porosity, permeability, and pay zone should be known. The paper describes the growth medium for injection; protected fermentations; pasteurization; mixing of chemicals; scheduling; injection; and reservoir hold time.

34530 (DOE/BC/10852—1, pp 247-256) **MEOR applications to heavy oil.** Donaldson, E.C. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

Areas of research are recommended for the ex-situ applications of biosurfactants for heavy oil processing, storage, and transport; for in-situ applications of biosurfactants for heavy oil recovery; for the chemical composition of heavy oils and screening of bacteria which are capable of breaking down heavy oils; and for paraffin deposition at production wells. 5 references.

34531 (DOE/BC/10852—1, pp 257-268) **Summary of MEOR field tests with a look to the future.** Hitzman, D.O. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A request is made for data on recent field tests of MEOR technology. The paper then summarizes the application of MEOR technology in well clean out, waterflooding, biopolymer flooding, water diversion agents, prevention of microbial growth, and surface release and heavy oil applications. New developments related to MEOR technology are briefly mentioned.

34532 (DOE/BC/10852—1, pp 272-286) **Report from workshop groups: formation evaluation and selection.** Knapp, R.M. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A checklist is given of data which needs to be obtained for formation evaluation and selection of MEOR process to be used. Discussed are the objective of the proposed treatment, identification of wells, well bore condition, sources of data, rock data, fluid data, microbe choices, injection protocol, monitoring program plan, and post-treatment analysis. Research needs are briefly discussed.

34533 (DOE/BC/10852—1, pp 287-311) **Report from workshop groups: microbial screening.** Foster, T.L.; Lazar, I. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A discussion was summarized on the selection of microorganisms, screening techniques for metabolic by-products, optimization of the selected microorganisms, testing of mono or mixed cultures, storage of selected cultures, and matching microorganisms for specific reservoir recovery requirements. Research needs for improved microbial selection and optimization were defined.

34534 (DOE/BC/10852—1, pp 312-318) **Report from workshop groups: laboratory to field scale-up.** Zajic, J.E.; Swan, A.G. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The workshop recommended research on the development of the protected fermentation concept and on the kinetics of microbial growth and product formation. Recommendations were also given for scale-up requirements: microbe selection data, design information, injection and control equipment. General recommendations included international cooperation and information exchange on MEOR development and better communications between oil men, university researchers, and biotechnology service companies.

34535 (DOE/BC/10852—1, pp 319-330) **Report from workshop groups: MEOR applications to heavy oil.** Donaldson, E.C. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

A summary is given of the research needs recommended by the workshop participants. These include the elucidation of the structure of heavy oil components, screening of anaerobes and thermophiles that can reduce the viscosity of heavy oils, testing of biosurfactants for applications in emulsions and thermal recovery, and the search for microbes that will degrade paraffins at production wells.

34536 (DOE/BC/10852—1, pp 331-344) **Report from workshop groups: laboratory core studies.** Jack, T.R.; Jang, L. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

Highlights of the workshop discussion are presented to illustrate the scope of core studies necessary to develop a successful MEOR process for a given reservoir. Three areas of core studies are discussed: facial plugging, penetration of bacteria and nutrients, and EOR effect. In discussing the procedures involved in core studies, the following areas were described: materials, preparation, methods, experiments, and use of data.

34537 (DOE/BC/10852—1, pp 356-371) **Report from workshop groups: injection protocol.** Yen, T.F.; Shaffron, M. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

This discussion focussed upon the chemical, physical, and biological processes and forces that are involved in the MEOR technology and assessed the extent of current knowledge in these areas. Emphasis for development of the injection protocol was placed on activities at the wellhead, downhole at the injection point, and within the formation itself. The timing constraints associated with the injection procedure were also discussed as well as the availability or lack of information necessary for establishing an effective injection protocol.

34538 **(PB—87-166492/XAB) Applications for concrete offshore.** (Raytheon Co., Bedford, MA (USA). Missile Systems Div.). 1982. 155p. (UEG/UR—20). NTIS PC$118.00/MF$118.00.

The report collects and summarizes the various proposals for development offshore which have in common the use of concrete as the main structural material, and where possible, indicates their relative feasibility. A study encompassing such diverse schemes as offshore windmills, concrete LNG carriers, hydrocarbon production platforms and floating airports cannot be completely exhaustive on each subject, so references to sources of further information have been given wherever possible. Details of individual projects and proposals are included for Power plants, Hydrocarbon production platforms, Concrete ships, Storage systems and industrial plants, Subsea systems, Offshore islands, Coastal works and Other concrete structures.

34539 **Non-Newtonian fluid flow in a reservoir - An application to hydraulic fracturing.** Torok, J.S.; Advani, S.M. (Dept. of Mechanical Engineering, Rochester Institute of Technology, Rochester, NY 14623). *Journal of Energy Resources Technology;* **109**: No. 1, 6-10(Mar 1987).

A formulation for the flow of a power law non-Newtonian fluid in a porous-permeable medium represented by a nonlinear partial differential equation is presented. This governing equation is transformed into a nonlinear ordinary differential equation whose solution is expanded as a Lie series. As an application to hydraulic fracturing, the problem of a Newtonian reservoir fluid being displaced by an injected non-Newtonian fluid is discussed. The resulting moving boundary problem is solved, resulting in explicit solutions for the respective pressure distributions and the displacement of the moving interface. The presented solutions provide a firm theoretical basis for fluid loss characterization in the porous-permeable reservoir.

0205 Products And By-products

REFER ALSO TO CITATION(S) 34774

34540 **(AD-A—178471/9/XAB) Electron paramagnetic resonance on asphaltic materials. Final report, October 1984-September 1985.** Humphrey, B.J. (New Mexico Engineering Research Inst., Albuquerque (USA)). Jan 1987. 48p. (NMERI-WA—5-10-(SS-5.01)). NTIS, PC A03/MF A01.

Asphalts have been used as paving materials for many years and a great deal of research has been conducted in the physical properties needed for good for good performance. In the past, some chemical research has been performed on these materials as well. Questions have remained as to what chemical properties are important in the design of a long-lasting pavement structure. This study has used a spectroscopic technique to investigate the aging and catalytic properties of asphalts. Electron paramagnetic resonance (EPR) was used to identify the role of free-radical species in these processes. Two paramagnetic categories were identified: organic free radicals and vanadium transition-metal ions. Free radical and transition metals are highly reactive, and may play important roles in the oxidation process that contributes to aging. The results of this study indicate that there may be a relationship between the

concentrations of the free radical species to the aging index and to the changes in the specific clay gel fractions.

34541 **(AD-A—178559/1/XAB) High-density jet-fuel supply and specifications. Final report, August 1985-January 1986.** Smits, C.M. (Battelle Columbus Labs., OH (USA)). Jan 1986. 91p. NTIS, PC A05/MF A01.

High-density kerosene-type jet fuels are being examined by the US Air Force in order to increase the range of volumetrically limited military aircraft. Present JP-8 fuels range from 37 to 51 API (0.775-0.840 g/cc) and contain approximately 124,000 Btu/gal (net). Target high-density fuels of less than 37 API (0.84 g/cc) would have net heating values greater than 130,000 Btu/gal and could extend aircraft range as much as 15%. Two sources of these types of fuels, straight-run cuts from naphthenic crude oils and refinery hydrocracker product streams, were examined as to availability, quality of the product, and need for further processing. Results of that study are reported here.

34542 **(AD-A—178828/0/XAB) Gum and deposit formation from jet-turbine and diesel fuels at 100 C.** Mayo, F.R.; Lan, B.Y. (SRI International, Menlo Park, CA (USA)). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in Industrial and Engineering Chemistry Research, Vol. 26, No. 2, 215-220(1987).

Rates of oxidation and gum formation for six hydrocarbons, three jet-turbine fuels and three diesel fuels have been measured at 100 C in the presence of t-Bu2O2 tert-butyl-peroxide as initiator. Four of six fuels oxidize faster at 100 C than in previous work at 130 C with initiator. Four any single substrate, the amount of gum produced for the oxygen absorbed is similar at 100 and 130 C even with large changes in rates and t-Bu2O2 concentrations. Thus, one mechanism of gum formation is intimately associated with oxidation. The effects of t-Bu2O2 concentration on the rates of oxygen absorption and gum formation show that gum formation is associated with chain termination by two peroxy radicals. In general, the pure hydrocarbons have long kinetic chains and give good yields of hydroperoxides. The fuels give short kinetic chains and produce little hydroperoxide but but much more gum formation is the coupling of substrates by peroxides in the absence of oxygen. The mechanism, condensation of oxidation products from alkylnaphthalenes, is also proposed.

34543 **(PB—87-163499/XAB) Characterization of diesel fuel in NIOSH (National Institute for Occupational Safety and Health) Diesel Exhaust/Coal Dust Study.** Choudhary, G.; Posner, J.C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 1983. 14p. NTIS, PC A02/MF A01.

See also PB—87-163515.

Measurements were taken of various parameters to determine the characteristics of the bulk diesel fuel which was used in the NIOSH Diesel Exhaust/Coal Dust study. The parameters examined included: volatility (as determined by boiling point), weight percent of aromatics, saturates, olefins, carbon, hydrogen, nitrogen, sulfur, and oxygen. During the period of study, the initial batch of diesel fuel was replaced with a new batch on five different occasions. Fuel was sampled monthly, with additional samples taken when there was a new fuel batch. While there were some variations observed in the values of the parameters measured, the overall characteristics of the six batches were not significantly different. When the sample to be studied was taken after a few months of storage in the storage tank following a batch change, some abnormal values, particularly the maximum boiling point of the fuel and some changes in elemental analysis did result.

0206 Health And Safety

34544 **(DGMK—248-03) Methods for estimation of the amounts of two-phase hydrocarbon discharge.** Leuckel, W.; Nastoll, W. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.)). Dec 1985. 57p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-11071.

In the report the basic principles of the numerical evaluation of hydrocarbon discharge processes given in the DGMK research report 248-02 are extended to two-phase flows. This should provide additional assistance in carrying out plant safety evaluations in accordance with the safety regulations of the FRG. The two-phase flow resulting from the evaporating liquid is treated as a quasi-continuum. The necessary assumptions about reaching the thermodynamic equilibrium as well as the slip between the liquid and the vapour phase are made in such a way that, with respect to the safety considerations, a conservative result is obtained. With 18 figs., 4 tabs., 11 refs.

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 34972

34545 **Oil consumption in the developing countries to the year 1995.** Brooks, H.S. (Energy Information Administration, Office of Energy Markets and End Use, United States Dept. of Energy). pp 3-9 of Energy decisions for the future: Challenge and opportunities. Miyato, M.; Matsui, K. Tokyo, Japan; Institute of Energy Economics (1986). (CONF-860656—).

From 8. annual international conference of the International Association of Energy Economists: energy decisions for the future - challenge and opportunities; Tokyo, Japan (5 Jun 1986).

Oil consumption in the developing countries (including OPEC) is projected to increase by over 20 percent between 1985 and 1995 (Table). This is about double the rate of consumption growth projected for the industrial countries of the OECD. As a group, OPEC is projected to have the highest growth in oil consumption, approximately 3.5 percent per year as compared to 1 percent for the total market economies. However, there is considerable uncertainty around this base case projection. OPEC consumption by 1995 could increase by 0.9 to 1.8 million barrels per day from a 1985 estimate of 3.2 million barrels per day; other developing countries by 1995 could increase by 0.5 to 1.7 million barrels per day from a 1985 estimate of 8.3 million barrels per day. Capital intensive projects such as coal and nuclear power plants and natural gas pipelines are less prevalent in most developing regions due in part to scarce capital resources and the inability to borrow due to the large external debt positions of most of these nations. Thus, there are fewer alternatives to oil in these regions. Though heavily dependent on oil as a primary energy source, the developing countries are expected to make every effort to exploit domestically produced energy sources in order to reduce oil imports and conserve foreign exchange.

34546 **Oil demand in Asian developing countries: Historical and current trends.** Sathaye, J.; Meyers, S. (Energy Analysis Program, Lawrence Berkeley Lab., Berkeley, CA 94720). pp 38-52 of Energy decisions for the future: Challenge and opportunities. Miyato, M.; Matsui, K. Tokyo, Japan; Institute of Energy Economics (1986). (CONF-860656—). Contract AC03-76SF00098.

From 8. annual international conference of the International Association of Energy Economists: energy decisions for the future - challenge and opportunities; Tokyo, Japan (5 Jun 1986).

This report describes recent changes in oil demand, the underlying causes of those changes, and assesses future trends for the major Asian developing countries (excluding China). The historical period covered is 1973-83, with the main focus on the period for which we had sectoral data for all of the countries, 1978-83. Unlike studies which focus on the effect of prices and income on the demand for oil, the authors research examines the physical determinants of oil demand by sector. They use indicators in each sector to relate oil demand to structural change. Understanding this relationship will allow development of better forecasts and policy tools for improved management of demand.

34547 **Investment strategies of petroleum companies in a restructured environment.** Coburn, L.L. (Div. of Competition, U.S. Dept. of Energy). pp 368-387 of Energy decisions for the future: Challenge and opportunities. Miyata, M.; Matsui, K. Tokyo, Japan; Institute of Energy Economics (1986). (CONF-860656—).

From 8. annual international conference of the International Association of Energy Economists: energy decisions for the future - challenge and opportunities; Tokyo, Japan (5 Jun 1986).

The stated purpose of this paper is to document the extent of restructuring and examine what, if any, effect restructuring has on the short-term investment strategies of petroleum companies. The documentation shows that restructuring over the 1981-1985 period is extensive totaling about $133.7 billion. More than half was done voluntarily, with about 41 percent of the value attributable to defensive actions. The analysis indicates that short-term investment strategies changed in many ways, often producing conflicting effects. These short-term strategies also may be the companies' long-term strategies as well. Only time will tell. But it is important to let the market response--restructuring--to uncertainty in determining oil company values continue unfettered, since this response is the most efficient way to sort out diverse and divergent viewpoints.

0208 Waste Management

34548 (PB—87-166369/XAB) Review and evaluation of current design and management practices for land-treatment units receiving petroleum wastes. Martin, J.P.; Sims, R.C.; Matthews, J. (Utah State Univ., Logan (USA). Utah Water Research Lab.). 1986. 22p. NTIS, PC A02/MF A01.

Pub. in Hazardous Waste and Hazardous Materials, Vol. 3, No. 3, 261-280(1986).

The paper describes the land-treatment practices used by petroleum-waste land-treatment facilities in the U.S. Information obtained for 13 full-scale land-treatment facilities included types of waste land treated, characterization of land-treated wastes, waste application rates (loading rates), waste application frequencies, and management practices used at the treatment units. Engineering design matrices which illustrate the relationships among waste application rate, application frequency, and waste degradation rate, and the effect of these parameters on stabilized concentrations during the active life of a unit were developed.

34549 (SAND—87-1129C) Outline for Industrial hygiene and safety in hazardous waste management. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 5p. (CONF-8704146—1-Summ.). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009078.

From Annual conference of the New Mexico chapter of the American Society of Safety Engineers; Albuquerque, NM, USA (30 Apr 1987).

An outline is provided of management of hazardous wastes with reference to safety and industrial hygiene. Main headings of the outline are routine hazardous waste operations, remedial actions, and OSHA standards for hazardous waste workers. 10 refs. (DT)

34550 Catalytic upgrading of used lubricating oils. Bhan, O.K.; Tai, W.P.; Brinkman, D.W. (National Institute for Petroleum and Energy Research, Bartlesville, OK 74005). *Fuel Science and Technology International;* 4: No. 3, 303-326(1986).

Several commercial catalysts were tested for their activity for upgrading waste lubricating oils. The feedstock was vacuum distilled to remove the light and the heavy ends. Two trickel-bed reactors placed in series were employed, the top reactor contained a high surface area alumina and the bottom reactor the catalyst. A Ni-Mo-Al/sub 2/O/sub 3/ catalyst was selected for further study on the basis of its higher activity and activity maintenance. Several different hydrogen pressures, reactor temperatures, and liquid volume hourly space velocities were employed to arrive at the most optimum process conditions. This paper discusses the effect of catalyst and process conditions on the product liquid color, viscosity, nitrogen, and sulfur content.

0209 Environmental Aspects

34551 (BNL—39542, pp 54) Feasibility of detecting PFT-tagged oil leaks from high pressure oil-filled underground transmission cables. Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Leakage of oil from underground high-pressure oil-filled transmission cables can be detected most readily by the addition of a PFT (perfluorocarbon tracer) vapor to the oil with subsequent measurement of those PFT vapors above the ground. Using the proven perfluorocarbon tracer (PFT) technology, which allows the determination of concentrations as low as 0.0003 parts per trillion in air, it is shown that tagging cable oil with a PFT at about 0.1% by weight will provide detection of a 1 gal/h leak after 1 day of leakage when sniffing the air within 10 m of the leak location; the cost of the PFT taggant would be about 10% of the cost of the oil. The purpose of this study is to determine the probability of successfully developing this detection technique and to establish the protocols for detecting a leak, pinpointing its origin, and estimating the magnitude of the leak.

34552 (DOE/BC/10852—1, pp 345-355) Report from workshop groups: environmental constraints of MEOR. Updegraff, D.M.; Jenneman, G. Jan 1987. NTIS, PC A16/MF A01. File Number DE87001216. (CONF-8604299—).

From 1. international MEOR workshop; Abilene, TX, USA (1 Apr 1986).

The paper discusses the effects of additional introduced substrate on sulfate reducing bacteria, the risk analysis which should be applied to MEOR, state and federal regulations, and environmental data available on MEOR. The paper recommends research on waste disposal methods, water quality monitoring, sampling methods, and containment of the injected bacteria to the area of interest.

34553 (PB—87-164331/XAB) Industrial-hygiene survey report of Plateau, Incorporated, Bloomfield Refinery, Bloomfield, New Mexico. Cox, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Oct 1986. 64p. (IWS—124.10). NTIS, PC A04/MF A01.

Turnaround operations at a fluid catalytic-cracking unit at the Bloomfield Refinery, in Bloomfield, New Mexico, were investigated for possible exposure of workers to various chemical agents, including hexavalent chromium, coal tar pitch volatiles, nitrogen-dioxide, sulfur dioxide, respirable dusts, and welding fumes. The average level of nitrogen dioxide in the air was 1.5 parts per million (ppm); the value for sulfur dioxide was 2.5ppm. NIOSH standards for hexavalent chromium (0.025mg/cu m for water soluble and 0.001mg/cu m for water insoluble) were exceeded. Respirable dust levels above 5 mg/cu m were noted during cleaning operations. In many welding steps the concentration of welding fumes was in excess of 5 mg/cu m as well. At the plasma arc cutting operation, concentrations of carbon monoxide, nitrogen dioxide, and sulfur dioxide (airborne) were 11.1, 1.5, and 2.5 ppm, respectively. During removal of coke from the reactor, CTPV levels exceeded the standard of 0.1 mg/cu m. The author recommended that monitoring of the air be undertaken on a regular basis and that protective clothing and equipment be used by the workers. Ventilation rates and the direction of the ventilation should be checked.

34554 (PB—87-166807/XAB) Impact of drilling fluids on seagrasses: an experimental community approach (journal version). Morton, R.D.; Duke, T.W.; Macauley, J.M.; Clark, J.R.; Price, W.A. (University of West Florida, Pensacola (USA). Dept. of Biology). 1986. 16p. NTIS, PC A02/MF A01.

Pub. in Community Toxicity Testing, ASTM STP 920, 199-212(1986); See also PB—85-212124.

Effects of a used drilling fluid on an experimental seagrass community (Thalassia testudinum Konig et Sims) were measured by exposing the community to the suspended particulate phase (SPP) in laboratory microcosms. Structure of the macroinvertebrate assemblage, growth, and chlorophyll content of grass and associated epiphytes, and rates of decomposition as indicated by weight loss of grass leaves in treated and untreated microcosms were compared. There were statistically significant differences in community structure and function among untreated microcosms and those receiving the clay and drilling fluid. For example, drilling fluid and clay caused a significant decrease in the numbers of the ten most numerically abundant (dominant) macroinvertebrates, and drilling fluid decreased the rate at which Thalassia leaves decomposed.

34555 **(PB—87-166955/XAB) Biochemical measures of coral metabolic activity, nutritional status, and microbial infection with exposure to oil- and gas-well drilling fluids.** White, D.C.; Nickels, J.S.; Gehron, M.J.; Parker, J.H.; Martz, R.F. (Florida State Univ., Tallahassee (USA). Dept. of Biological Science). Mar 1987. 28p. NTIS, PC A03/MF A01.

The reef building coral Montastrea annularus was exposed continuously to suspensions of oil- and gas-well drilling fluids at concentrations of 0.1 ml/liter, 0.01 ml/liter, and 0.001 ml/liter in flowing seawater at the U.S. Naval Stage I platform. After 6 weeks exposure, coral fragments of 30 to 60 sq cm surface area were broken off, rinsed in seawater, and extracted in a one-phase chloroform-methanol seawater extract and returned to the laboratory, the lipids were analyzed for their phospholipid content, alkyl fatty acid composition, and neutral lipid triglyceride glycerol. The aqueous phase was analyzed for free amino acid composition. Biochemical evidence of stress was reflected in the cessation of growth as measured in depressed diacyl phospholipid. Detailed analysis of the acyl fatty acid composition by capillary gas chromatography showed changes in polyenoic fatty acids, suggesting possible changes in the metabolism of the fatty acids induced by the exposure to the drilling fluids.

34556 **(PB—87-169579/XAB) Toxicity of used drilling fluids to mysids (Mysidopsis bahia).** Gaetz, C.T.; Montgomery, R.; Duke, T.W. (Environmental Protection Agency, Gulf Breeze, FL (USA). Environmental Research Lab.). 1986. 11p. (EPA—600/J-86/237). NTIS, PC A02/MF A01.

Pub. in Environmental Toxicology and Chemistry, Vol. 5, 813-821(1986).

Static, acute toxicity tests were conducted with mysids (Mysidopsis bahia) and 11 used drilling fluids (also called drilling muds) obtained from active drilling platforms in the Gulf of Mexico, U.S.A. Each whole mud was tested, along with three phases of each mud: a liquid phase with all particulate materials removed; a suspended particulate phase composed of soluble and lighter particulate fractions; and a solid phase composed mainly of drill cuttings and rapidly settling particulates. These muds represented seven of the eight generic mud types described by the U.S. Environmental Protection Agency for use on the U.S. Outer Continental Shelf. The toxicity of the 11 muds tested was apparently enhanced by the presence of aromatics. Furthermore, one mud tested repeatedly showed loss of toxicity with time, possibly from volatilization of aromatic fractions. The data demonstrated that aromatics in the drilling fluids affected their toxicity to M. bahia.

0210 Legislation And Regulation

34557 **(PB—87-165114/XAB) Federal offshore oil and gas leasing. Alaska Outer Continental Shelf region: document preparation, bidding, and leasing procedures. Final report.** Sires, B.J. (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Dec 1986. 196p. (OCS/MMS—86/0105). NTIS, PC A09/MF A01.

The report provides guidelines for participation in oil-and-gas lease sales conducted by the Alaska Outer Continental Shelf Region and for maintenance of record title interest of leases.

0230 Properties

REFER ALSO TO CITATION(S) 35091

34558 **(DGMK—289-06) Literature review with respect to the application of thermal analysis methods to petroleum and related products.** Ohrbach, K.H.; Kettrup, A. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.); Paderborn Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik). Sep 1986. 152p. (In German). NTIS, PC E14; Available from NTIS as TIB/B87-05911.

In this review 174 publications are presented dealing with the application of thermal analysis methods (TG, DTG, DTA, DSC, PDSC) to petroleum and related products, and covering the literature until October 1985. The basic principles of thermal analysis are reported, and a compilation of conventional test methods is given. All of the publications are listed in alphabethic order (by author), and abstracts were prepared (in German). Results from the papers are summarized in the relevant sections preceeding the individual abstracts.

34559 **Analysis of metalloporphyrins in petroleum using tandem mass spectrometry.** Brodbelt, J.S.; Cooks, R.G.; Wood, K.V.; Jackson, T.J. (Dept. of Chemistry, Purdue Univ., West Lafayette, IN 47907). *Fuel Science and Technology International;* **4**: No. 6, 683-699(1986).

Vanadyl deoxophylloerythroetioporphyrins (DPEP) and vanadyl etioporphyrins (ETIO) have been identified in Gato Ridge and Boscan petroleum samples using a combination of isobutane chemical ionization and tandem mass spectrometry. In addition, particular porphyrins such as the C/sub 30/ vanadyl DPEP and ETIO species were identified in a crude oil containing approximately 500 ppm total porphyrins, with only minimal sample clean-up.

0240 Storage

REFER ALSO TO CITATION(S) 35434

34560 **(PB—87-171278/XAB) Underground storage tank corrective-action technologies. Final report, January-December 1986.** Cochran, R. (PEI Associates, Inc., Cincinnati, OH (USA)). Jan 1987. 205p. NTIS, PC A10/MF A01.

The document contains information on corrective-action technologies for releases from underground storage tanks (UST). It probes general background information on UST construction techniques, leak-detection methods, and failure mechanisms. It also addresses transport pathways of released substances, techniques for evaluating the extent of a release, factors influencing risk to human health and the environment, techniques for selecting initial corrective-action response technologies, and detailed technical profiles of corrective-action technologies. Emphasis is on corrective actions associated with releases from gasoline and petroleum USTS.

34561 **(SAND—86-0876C) Borehole creep closure measurements and numerical calculations at the Big Hill Texas SPR [Strategic Petroleum Reserve] storage site.** Preece, D.S.; Beasley, R.R.; Goin, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1986. Contract AC04-76DP00789. 20p. (CONF-870815—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003152.

From 6. International Society for Rock Mechanics congress; Montreal, Canada (30 Aug 1987).

The Big Hill Texas salt dome is being developed as an additional site for the US Strategic Petroleum Reserve (SPR). Ten deep (1433 m) boreholes were drilled in 1983 for leaching the first five storage caverns. Leaching has been delayed and the ten wells have been used to study the in-situ creep behavior of rock salt. Creep closure has been quantified by measuring wellhead pressure rise, volume of brine on pressure bleed-down and by performing caliper logs several years apart. Finite element calculations of borehole creep closure have also been performed. The calculated creep displacement of the borehole wall was used to compute volume change which could be used to compute wellhead pressure rise. The calculated volume change and wellhead pressure rise were found to underpredict the field data by a factor of 2.5. The calculated displacements underpredicted measured borehole closures by a factor of 4. This exercise has resulted in a better understanding of the in-situ behavior of rock salt and our ability to predict that behavior with finite element computer programs. 18 refs., 7 figs., 3 tabs.

0250 Combustion

REFER ALSO TO CITATION(S) 34513, 35091

03 NATURAL GAS

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 34538

0304 Products And By-products

REFER ALSO TO CITATION(S) 35329

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 34972

34562 **(PB—87-185179/XAB) Sample selection for the 1986 GRI (Gas Research Institute) energy-price survey. Topical report.** Schoening, N.C. (Alabama Univ., Huntsville (USA). Center for High Technology Management and Economic Research). Dec 1986. 55p. NTIS, PC A04/MF A01.

To perform evaluations of gas-fueled and competing technologies in the residential and commercial sectors, complete and accurate information on fuel prices is necessary. This report describes the development of a new sample of electric and gas utilities to be used in analyzing and reporting utility rate data to GRI (Gas Research Institute). Data are collected each year from this sample of electric and gas utilities in the United States and are then used to compute the operating costs of technologies under consideration. The new sample developed in the study maximizes the coverage of utility customers by including the largest electric and gas utilities in the United States while minimizing the cost of future studies by reducing the sample size.

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 34555, 35581

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 34539

34563 **(DGMK—167-4) Material properties and model investigations related to frac propagation during stimulation tests in low permeability sediments of North-German gas formations. Final report - part 1 of DGMK-project 167/3: Stimulation of low permeable deep gas-reservoirs (phase 3).** Rummel, F.; Heuser, U.; Mueller, W.; Otto, F. (Deutsche Gesellschaft fuer Mineraloelwissenschaft und Kohlechemie e.V., Hamburg (Germany, F.R.); Bochum Univ. (Germany, F.R.). Inst. fuer Geophysik). Nov 1986. 137p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-05909.

Methods and results of the research phase 1983-1986 are published as a contribution to a hydraulic fracturing approach on the basis of linear elastic fracture mechanics. The following experimental investigations were conducted: - determination of frac-specific properties of rocks from the North-German gas formations Carboniferous and Rotliegend - investigation of the effects of pressure, temperature, stress and chemical environment on these properties - frac experiments to simulate the frac propagation under definite boundary conditions, especially at lithological discontinuities. On the basis of this experimental program a realistic geophysical frac propagation model is developed.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 34557

0320 Transport, Pipelines, And Handling

34564 **(NP—7770098) Control of adjustable displacement units in constant-pressure networks.** Murrenhoff, H. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 24 Jan 1983. 154p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770098.

Hydraulic drives have the advantage of high power density and good control characteristics and are therefore suited for a wide range of applications. The author discusses the available techniques of variable displacement motor control in constant-pressure networks. Speed control, positional control, power control, and torque control, either hydraulic-mechanical or electro-hydraulic, are discussed. Design calculations are carried out for a pre-controlled hydraulic-mechanical and a pre-controlled electro-hydraulic control unit, and practical tests are made on existing drives. An experimental unit will be constructed for disturbance investigations and for the recording of steady-state characteristic fields. The applicability of a positive displacement engine in a positional control circuit is investigated. (HAG).

34565 **(PB—87-184297/XAB) Economic assessment of guided extended-range boring systems for installing gas distribution pipe. Topical report.** Pittard, G.T. (Maurer Engineering, Inc., Houston, TX (USA)). Dec 1986. 87p. (MEI-TR—86-25). NTIS, PC A05/MF A01.

Applications and economic value of guided extended-range boring systems (EBS) for installing gas distribution pipe is assessed. The system is comprised of surface drilling frame, pipe-mounted mechanical boring and steering hardware and electronic-guidance instrumentation. The type of drilling conditions determine whether a percussive or air rotary-drilling head is used. The percussive head is used in compactible soils while the air rotary drill is for more difficult soils and rock. The technical approach was to characterize gas-distribution construction activities in terms of expenditures, number of new and replacement mains and services, installation distances, bored versus open-cut construction, etc. This information was combined with the EBS field-generated performance and cost data to establish potential cost savings and the system's impact on the gas-distribution industry. Research indicates that: almost one-fourth (23%) of gas mains could be installed at significant savings if EBS is used in place of conventional equipment. Primary application for EBS is the installation of new and replacement gas mains beneath streets and other high-restoration-cost areas. Mains installation in open-land right-of-ways can still be done least expensively with open-cut excavation. EBS appears capable of reducing in-road main installations by 50% in comparisons to open-cut excavation and 35% versus conventional boring equipment.

0330 Properties

34566 **(PB—87-164430/XAB) Analyses of natural gases, 1985. Information Circular/1985.** Moore, B.J.; Sigler, S. (Bureau of Mines, Amarillo, TX (USA). Helium Field Operations). 1986. 188p. (BM-IC—9096). NTIS, PC A09/MF A01.

See also PB—86-155983; Library of Congress catalog card no. 86-600241.

The publication contains analyses and related source data for 517 natural gas samples from 25 States and 1 foreign country. Of the total samples, 298 were collected during calendar year 1985; the remainder were collected earlier, but releases granting permission to publish were not received before 1985. All samples were obtained and analyzed as part of Bureau of Mines investigations of the occurrences of helium in natural gases of countries with free-market economies. The survey has been conducted since 1917. The analyses published herein were made by mass spectrometer and chromatograph.

0340 Combustion

REFER ALSO TO CITATION(S) 35087

34567 **(PB—87-184289/XAB) Firetube boiler fiber burner development program. Final report, September 1982-September 1986.** Krill, W.V.; Pam, R.L.; Kesselring, J.P. (Alzeta Corp., Santa Clara, CA (USA)). 31 Dec 1986. 149p. (REPT—86-703-131). NTIS, PC A07/MF A01.

See also PB—85-180503.

The results of a 48-month program to perform field evaluations of durability of the Pyrocore radiant fiber burner in gas-fired firetube boilers are presented. These activities included selection of four industrial test sites; testing of a prototype segmented burner; design, construction, and installation of the four field test units; and field testing of the boilers with both conventional and fiber burners. The burner designs and potential control schemes for achieving various turndown capabilities are discussed. The unique aspects of each test site and installation are described, and the test results and benefits over the evaluation period are presented. Burner modifications implemented to reduce cost and enhance reliability are included. Additional tasks to develop a fuel-oil-firing capability for dual-fuel operation, and to improve the durability of the ceramic materials comprising the burner, are also summarized.

34568 **Combustion-torch ignition: Fluorescence imaging of OH concentration.** Cattolica, R.; Vosen, S. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). *Combustion and Flame;* **68**: No. 3, 267-282(Jun 1987).

The temporal and spatial development of the OH concentration during the ignition of a lean methane air-mixture (phi = 0.65) by a combustion torch has been studied. In the experiment the combustion torch was formed by a jet of high temperature combustion product gases that exit a thin-plate circular orifice connecting a small cylindrical prechamber with the main combustion chamber. This starting jet was driven by a spark-ignited flame which propagates through the prechamber. By decreasing the diameter of the prechamber orifice the initial gas velocity of the combustion torch was systematically increased. With this variation in velocity the flow field of the combustion torch, determined from high-speed schlieren videography, was altered significantly.

0350 Storage

REFER ALSO TO CITATION(S) 35434

34569 (NP—775244C, pp 100-101) **Eastern Steiermark natural-gas underground storage tank, geological preselection.** Graef, W. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltgeologie und Angewandte Geographie). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

Suitable storage rocks were examined under geological and technical aspects. This allowed to identify those regions which revealed to be promising for gas storage and which will be further studied.

34570 **Insulating polymer concrete for LNG impounding dikes.** Fontana, J.J.; Steinberg, M. (Sciences Div., Brookhaven National Lab.). pp 633-635 of American Gas Association 1986 operating section proceedings. Arlington, VA; American Gas Association (1986). (CONF-8604218—).

From American Gas Association: distribution/transmission conference; Chicago, IL, USA (28 Apr 1986).

86-DT-15.

An insulating polymer concrete (IPC) composite has been developed under contract to the Gas Research Institute for possible use as a dike insulation material at Liquid Natural Gas (LNG) storage facilities. In the advent of an LNG spill into the impounding dike area, the boiloff rate of the LNG can be substantially reduced if the surfaces of the dike are insulated. This increased safety at the LNG facility will tend to reduce the hazardous explosive mixture with atmosphere air in the surrounding region. The dike insulation material must have a low thermal conductivity and be unaffected by environmental conditions. The IPC composites developed consist of perlite or glass nodule aggregates bound together as a closed cell structure with a polyester resin. In addition to low thermal conductivity and porosity, these composites have correspondingly high strengths and, therefore, can carry transient loads of workmen and maintenance equipment. Prefabricated IPC panels have been installed experimentally, and at least one utility is currently considering a complete installation at its LNG facility.

04 OIL SHALES AND TAR SANDS

0403 Drilling, Fracturing, And Mining

34571 **(SAND—86-2882C) Computational and experimental studies of the role of stemming in cratering.** Hommert, P.J.; Kuszmaul, J.S.; Parrish, R.L. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 14p. (CONF-870867—2). NTIS, PC A02. File Number DE87009500.

From 2. international symposium on rock fragmentation by blasting; Keystone, CO, USA (23 Aug 1987).

An extensive data set from a series of cratering experiments in oil shale is used as the basis for studying the effect of stemming on blasting. Two tests in the series were identical, with the exception that in one of the tests the blastwell did not contain stemming. The experimental data, which included electronic stress and acceleration data, high speed photographic records, and postshot formation assessment, indicated that the stemmed and unstemmed tests were essentially identical. In an effort to quantitatively evaluate the apparent minimal effect of stemming on these experiments, a dynamic solid response code, PRONTO, is used in conjunction with a constitutive model for rock failure to calculate the blastwell pressure histories. In addition, estimates of the long term pressure histories for the detonation products were made for both the case of blastwell venting in the absence of stemming and the case of gas expansion into the crack network for the stemmed geometry. The PRONTO calculations indicate that the early time expansion of the blastwell from the initial detonation pressure is the same with or without stemming. During the time period when the majority of the rock fracturing occurs, the blastwell pressure histories are independent of stemming. With respect to rock motion, the results of the study are less conclusive. While the presence of stemming significantly increases the potential momentum available to the rock, this momentum is not effectively transferred into greater rock dislocation in a cratering geometry. In other geometries, such as bench blasting, however, it is possible that long term gas pressure may be very important to rock motion. Therefore, it will be necessary to use rock motion models to examine the potential for long term gas pressure to significantly impact rock motion. 16 refs. 9 figs., 2 tabs.

0404 Oil Production, Recovery, And Refining

34572 **(DOE/FE/60177—2347) Western Research Institute: Annual technical progress report, April 1985-March 1986.** (Western Research Inst., Laramie, WY (USA)). May 1986. Contract FC21-83FE60177. 209p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010509.

The one-dimensional model of oil shale retorting has been modified to incorporate liquid-phase behavior of oil and water. The formation and deposition of oil mist, drainage of liquid oil, and gas pressure drop in rubble can be calculated using as many as 11 separate boiling fractions. Experiments on the decomposition of kerogen during pyrolysis have been done on two grades of western oil shale and on an eastern shale. Chemical and physical properties of the DOE interim reference oil shales have been measured using a variety of analytical methods. Parameters necessary to interpret the chemistry and physics occurring during in-situ thermal processing and those factors that influence the selection of tar sand resources for in-situ thermal processing were identified. Gas analyses by quadrupole mass spectrometry indicated that low temperature oxida-

tion of bitumen occurs during the startup of the in situ combustion process. Saturate hydrocarbons isolated from recovered oils were characterized by mass spectrometry. Three underground coal gasification (UCG) tests in the block reactor have verified that gasification pressure does not affect methane production from horizontal coal seams. The test results indicate that methane production from coal pyrolysis is not enhanced by methanation. At higher gasification pressures, the steam char reaction is inhibited by equilibrium, and the char thickness increases at the cavity sidewall. Water vapor and pyrolysis products from the coal flow through the hot char zone into the cavity. At the high temperatures near the cavity surface, thermodynamic equilibrium favors demethanation rather than methanation.

34573 **(DOE/LC/11067—2235-Vol.1) Indiana Shale Oil Development Project: Program for design and operation of a 500 BPD demonstration plant: Final report, Volume 1.** (Cliffs Engineering, Inc., Rifle, CO (USA)). Dec 1986. Contract FG21-85LC11067. 346p. NTIS, PC A15/MF A01; 1; GPO Dep. File Number DE87001039.

The purpose of this engineering study is to develop preliminary design and cost data (+-30%) pertinent to construction and operation of a 500 barrels per day, demonstration-scale oil shale retorting complex utilizing Allis-Chalmers' patented roller grate retort technology. Of primary concern is the minimizing of overall project costs without sacrificing goals det for the planned demonstration facility. These goals are defined as follows: demonstrate the ability and reliability of the roller grate device to process oil shale on a continuous basis; demonstrate the capability of the retorting process configuration to safely, economically, and reliably produce shale oil, high Btu gas, energy from residual carbon and other by-products with minimal environmental impact; and obtain design data and operating experience to be used for scaling up to commercial size shale retorting facilities. Preliminary design and cost data developed in this study will supplement similar information available from other engineering studies which have examined alternate retorting technologies and retorts of varying productive capacities. The new data will be beneficial to both governmental agencies and industry since it fills an information gap (i.e., demonstration-scale plant costs and technologies) not addressed by the other investigations. 19 figs., 14 tabs.

34574 **(DOE/METC—87/0254) Oil shale: Technology status report.** (USDOE Laramie Project Office, WY). Oct 1985. 52p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87001055.

In FY 85 the Oil Shale Program completed the transition to the new structure that began in FY 84. In FY 84 the Oil Shale Program was restructured to advance the understanding of oil shale conversion to a point allowing development of advanced concepts for the production of liquids from shale. Within the Oil Shale Program, the highest priority research is that required to generate pedigree data essential to the understanding of the conversion phenomena. These data will provide input for the private sector's commercial decision-making process. This research includes efforts in the fields of appropriate technology and environmental sciences to establish the data bases and predictive capability required to identify and mitigate potential problems. The principal participants in the new program are Los Alamos National Laboratory, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Morgantown Energy Technology Center, Sandia National Laboratory, Western Research Institute, and selected universities and private companies. The restructured program is to be accomplished in 10 years, in two 5-year phases. The first phase is designed to acquire the best possible data. The second phase is designed to use the data through systems analysis and environmental control technology development to design efficient, cost-effective, and environmentally acceptable conversion systems. The major activities that were initiated in FY 85, the first year of the restructured program, are described in this report. 73 refs.

34575 **Free radical equilibrium in the fluidized bed retort.** Coburn, T.T.; Droege, M.W. (Lawrence Livermore National Lab., CA). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The solid-recycle fluidized bed retort has been used to study gas phase equilibria in an oil shale pyrolyzer. In the LLNL pilot scale retort, light gases, methane, ethane, ethylene, and propylene, form in a ratio that is inconsistent with equilibration, and they are not equilibrated when recycled. However, the free radical precursors of these gases are completely equilibrated. Equilibration of intermediates is demonstrated with a study of the 1- and 2-butyl radicals. These intermediates are shown to be at thermodynamic equilibrium in a variety of fluidized bed retorting experiments. Free radical equilibria in the retort are established very rapidly, without need for gas recycle. The mechanism of equilibration is valid for the homologous series of free radicals, and offers a means to achieve improved liquid product yield.

34576 **Comparison of transport processes allowing organic matter to be recovered from Green River Shale at 400°C.** Mc Kay, J.F.; Blanche, M.S. (Western Research Institute, P.O. Box 3395, University Station, Laramie, WY 82071). *Fuel Science and Technology International;* 4: No. 1, 19-44(1986). Contract FC21-83FE60177.

One-inch blocks of oil shale were treated under three different reaction conditions at 400°C to determine the kinds and amounts of organic materials recoverable. Extractions with liquid and combined liquid-supercritical solvent were found to be effective methods of recovering organic material from shale. Supercritical fluid extraction with methanol-water was found to be more effective than distillation-liquid flow mechanisms; however, large amounts of oil remained in the shale. Low-molecular-weight nonpolar compounds were found to be the materials most easily recovered from shale while high-molecular-weight polar compounds were found to be the most difficult materials to recover.

34577 **Effect of time and pressure on recovery of oil from Green River oil shale in extraction experiments conducted at 400°C.** McKay, J.F.; Blanche, M.S. (Western Research Institute, P.O. Box 3395, University Station, Laramie, WY 82071). *Fuel Science and Technology International;* 4: No. 4, 413-432(1986). Contract FC21-83FE60177.

This paper describes the effect of time and pressure on liquid product yields when Treen River shale was exposed to supercritical methanol-water at 400°C and then extracted with benzene-methanol. Reaction times between 1 second and 34 minutes were studied as were pressures between 1800 and 5200 psi. Maximum yields of liquid product were obtained after a methanol-water treatment time of about 34 minutes. Pressure did not have a significant effect on product yields. Chemical characterization of selected liquid products is reported and it shows that the product composition varies with time. Exfoliation of shale also increases with treatment time.

34578 **Supercritical extraction of Israeli Mishor Rotem oil shale. 1. Batch extraction with toluene.** Yurum, Y.; Kramer, R.; Levy, M. (Hacettepe Univ., Dept. of Chemistry, Ankara). *Fuel Science and Technology International;* 4: No. 5, 501-530(1986).

Recovery of organic material from Israeli Mishor Rotem oil shale with toluene under supercritical conditions was investigated. The rate of solubilization, change of structural aspects and molecular weights of solubilized products with time were investigated. Experiments to recover organic material from shale were performed in a stainless steel high pressure autoclave. Shale sample was charged in a sintered glass crucible suspended from the cap of the autoclave; toluene was the solvent in all experiments. Solvent/shale ratio was 20; experimental temperature was 340°C.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 34575

34579 (DOE/FE/60177—2349) Selective dissolution and characterization of trace elements in hydrated and recarbonated retorted oil shale. Essington, M.E.; Sorini, S.S. (Western Research Inst., Laramie, WY (USA); USDOE Morgantown Energy Technology Center, WV). Sep 1986. Contract FC21-83FE60177. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010732.

A laboratory study was conducted at the Western Research Institute to evaluate the influence of hydration and recarbonation on the solid phase distribution of trace elements in retorted oil shale. The oil shale samples were retorted by the Paraho direct heating process and equilibrated in the laboratory under controlled carbon dioxide conditions. A sequential extraction technique was then used to fractionate trace elements into soluble, KNO_3-extractable, H_2O-extractable, NaOH-extractable, EDTA-extractable, HNO_3-extractable, and residual (nonextractable) phases. This procedure is purported to identify trace elements that reside in the soluble, easily exchangeable, adsorbed, organic, carbonate, sulfide, and silicate phases, respectively. The chemical fractions present in retorted oil shale and hydrated and recarbonated retorted oil shale are compared to identify trace element mineralogical changes that may occur in retorted oil shale disposal environments. The trace elements examined in this study included barium, cobalt, chromium, copper, lithium, manganese, molybdenum, nickel, lead, antimony, strontium, vanadium, and zinc. The extractabilities of the major elements - aluminum, calcium, iron, magnesium, and silicon - were also examined to provide evidence of solid phase elemental associations with trace elements. A significant result of this study is that the mineralogical residencies of trace elements in retorted oil shale were altered in response to hydration and recarbonation. Thus, the behavior of trace elements in retorted oil shale disposal environments may not be adequately predicted through the application of extraction procedures that assess potential trace element leachability. The results of this study also justify the further characterization of trace element selective extractabilities using procedures that partition trace elements residing in the HNO_3-extractable and residual fractions. 21 refs., 16 figs., 3 tabs.

34580 Influence of oxidative weathering on shale structure and on the subsequent devolatilization of oil shale. Khan, M.R. (Dept. of Energy, Morgantown, WV). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The effects of preoxidation on the composition of oil shale and the yield of shale devolatilization products are not well known. A western (Colorado) and an eastern (Kentucky) oil shale and their corresponding organic fractions (and a Pittsburgh seam coal, for comparison) were preoxidized in air at 150°C for up to 6 days or at 50°C for 292 days. Detailed pyrolysis behavior of these materials was subsequently determined by using techniques of thermogravimetric analysis combined with mass spectrometry (TGA/MS), microdilatometry, and elemental analyses. The findings by these techniques led to a hypothesis that preoxidation of oil shale organics introduces oxygen-crosslinking bridges and/or reduces the aliphatic hydrogen contents of the shale samples. The hypothesis was tested by Fourier transform infrared spectroscopy which confirmed that preoxidation of the shale organics introduces oxygenated functional groups such as carbonyl and carboxylic while there is a marked reduction in the aliphatic hydrogen content of the samples. The results suggest that part of the oxygen functional groups undergo decomposition and evolve during subsequent pyrolysis as H_2O and CO_2 at the expense of desirable hydrocarbon fuels.

34581 Ammonia evolution during oil shale pyrolysis. Oh, M.S.; Taylor, R.W. (Lawrence Livermore National Lab., CA). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Ammonia evolution during pyrolysis of three Green River Formation shales and one Eastern (Devonian) shale was studied. Most ammonia evolved during Fischer Assay-type pyrolysis was dissolved in retort water; the remaining was trapped in an acid solution. Ammonia concentrations were measured using an ammonia sensing electrode. The maximum pyrolysis temperature (T/sub max/) was varied from 350 to 750°C and the heating rate ranged 1 to 50°C/min. The yields of NH_3 increased rapidly at temperatures above the oil generating temperatures, showing a maximum at around T/sub max/ = 700°C and then decreased at T/sub max/ > 700°C due to decomposition of NH_3. The NH_3 yield showed a weak dependence on heating rate. The maximum yield of NH_3 was higher for Nitrogen (N) rich shale and the yield of NH_3 at T/sub max/ < 500°C reflected the organic N content. A simple kinetic model which takes account of NH_3 generation from organic and inorganic N sources and NH_3 decomposition was developed.

34582 Intrinsic oxidation kinetics of rapidly pyrolyzed oil shale. Fujimoto, F.D.; Braun, R.L.; Taylor, R.W.; Morris, C.J. (Lawrence Livermore National Lab., CA). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The authors have determined combustion rates for residual organic carbon and sulfide minerals in Green River oil shale retorted rapidly so that results will be relevant for design of aboveground oil shale plants. Shale was retorted by dropping it into a preheated sand bed fluidized by inert gas and the rate of oxidation was tracked by measurements of the CO_2 and SO_2 exit-gas concentrations. The SO_2 is released by sulfide oxidation, and can react with carbonates in the shale releasing CO_2. In order to determine the intrinsic kinetics of char combustion, they limited their measurements to temperatures between 380 and 480°C where CO_2 came from char combustion alone. They found char produced by rapid pyrolysis was approximately 2.5 times more reactive than char produced under Fischer assay conditions, and that the rate of combustion of sulfides is a little faster than char combustion.

34583 Mechanisms of synfuel degradation. 3. Interactive effects in nitrogen compound induced storage instability in shale derived diesel fuel. Cooney, J.V.; Beal, E.J.; Beaver, B.D. (Fuels Section, Chemistry Div., Naval Research Lab., Washington, DC 20375-5000). *Fuel Science and Technology International;* **4**: No. 1, 1-18(1986).

Deterioration in fuel quality upon storage has been a continuing problem in the utilization of middle distillate fuels. For diesel fuels, instability is usually defined by the formation of insoluble sediments and gums and by the accumulation of hydroperoxides. Gravimetric accelerated storage stability tests conducted with model compounds as dopants in otherwise stable distillate fuels have demonstrated that oxidative condensation reactions of polar heterocycles are deleterious to stability. In particular, nitrogen containing aromatics (pyrroles, pyridines, indoles, etc.) appear to be very harmful.

34584 Characterization and stability properties of polar extracts derived from a recent shale liquid. Mushrush, G.W.; Cooney, J.V.; Beal, E.J.; Hazlett, R.N. (Fuels Section, Code 6180, Naval Research Lab., Washington, DC 20375-5000). *Fuel Science and Technology International;* **4**: No. 1, 103-109(1986).

A shale fuel of marginal stability has been used as a source of nitrogen-rich polar extracts. Polar compounds were isolated by mild acid extraction followed by silica gel adsorption and were identified by GC/MS. Alkyl substituted pyridines were the prevalent class of compounds present in most extracts. The effects of adding these shale derived fractions as dopants to a stable shale diesel fuel (D-11) were examined in terms of sediment formation and peroxide number under accelerated storage stability test conditions. The activities of the extracts in inducing fuel instability were correlated with their composition.

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 34574, 34579

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 34574

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

REFER ALSO TO CITATION(S) 35896, 35897, 35898, 35899, 35900, 35901, 35902, 35903, 35904, 35905, 35906

34585 (DOE/ER/12074—T1) Predictive modeling of uranium roll front deposits: Final report. Ortoleva, P.; Chadam, J.; Moore, C. (Geo-Chemical Research Associates, Inc., Bloomington, IN (USA)). 22 May 1987. Contract AC02-82ER12074. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009660.

Mathematical and computational tools were developed for assessing criteria for the formation of uranium roll front mineralization. As a by-product, the methods developed were applicable to a much wider class of problems including other water-rock interaction related ore bodies and the trapping and migration of petroleum.

34586 (PB—87-167250/XAB) Availability of rare-earth, yttrium, and related thorium oxides - market economy countries. A minerals-availability appraisal. Information Vircular/1986. Anstett, T.F. (Bureau of Mines, Denver, CO (USA). Minerals Availability Field Office). 1986. 27p. (BM-IC—9111). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-600187.

The Bureau of Mines estimated the potential availability of rare-earth oxides (REO), including yttrium and thorium, which is also contained in the rare-earth bearing minerals monazite and bastnasite, from 38 properties in market-economy countries (MEC's). Only nine of the properties evaluated produce or would produce REO as the primary product; the others contain REO as a byproduct, chiefly from mineral-sands operations recovering rutile, ilmenite, and zircon. Nearly 77% (2,578,000 mt) of the total 3,355,000 mt of recoverable REO evaluated is from producing properties. At production capacities assumed for this evaluation, the amount of REO potentially available from producers ranges from an estimated 46,500 mt in 1986, to a peak of 50,900 mt in 1992, to 49,900 mt by the year 2000. Total MEC production in 1984 was estimated at 40,700 mt.

34587 Physiochemical studies of uraninite from an Oklo natural reactor. Curtix, D.B.; Eller, P.G.; Larson, E.M.; Karraker, D.R. (Los Alamos National Lab., NM). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Two billion years ago, over a span of a few hundred thousand years, the only known natural occurrence of sustained nuclear fission radically altered the isotopic, chemical, and mineralogical composition of the surrounding rocks. Today remnants of the event exist as lenses within the Oklo uranium mine in the African Republic of Gabon. Fission product abundances in one of the reactor zones revealed a striking relationship between the fission products Ruy, Pd, Te, and Mo. Eight samples contain widely varying quantities of these fission products but retain equal proportions, which leads to the conclusion that these elements make up a distinct secondary phase which should be detectable. They report here the results of that search by electron microscopy and EXAFS techniques. Another aspect of their study investigates the relationship between the distribution of iron(II) and iron(III) and the degree of fission-induced radiolysis, using EXAFS and Mossbauer spectroscopy.

0505 Uranium Enrichment

34588 (K/ITP—114) US and international export controls for the gas centrifuge. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1987. Contract AC05-84OT21400. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87008411.

After an overview of the nuclear fuel cycle and the gas centrifuge enrichment process, the historical aspects of international agreements to limit exports of such equipment are considered and the US implementation legislationto control exports of this ad related equipment are given in some detail. (LTN)

34589 (K/TS—11-861) Over facility design description for the CPDF [Centrifuge Plant Demonstration Facility]: SDD-1 [System Design Description]. (Science Applications, Inc., Oak Ridge, TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). Apr 1987. Contract AC05-84OT21400. 109p. NTIS, PC A06. File Number DE87009708.

The Centrifuge Plant Demonstration Facility (CPDF) is an essential part of the continuing development of first-production-plant centrifuge technology that will integrate centrifuge machines into a process and enrichment plant design. The CPDF will provide facilities for testing and continued development of a unit cascade in direct support of the commercial Gas Centrifuge Enrichment Plant (GCEP). The basic cascade-oriented equipment, feed, withdrawal, drive system, process piping, utility piping, and other auxiliary and support equipment will be tested in an operating configuration that represents, to the extent possible, GCEP arrangement and operating conditions. The objective will be to demonstrate procedures for production cascade installation, start-up, operation, and maintenance, and to provide proof of overall cascade and associated system design, construction, and operating and maintenance concepts. To the maximum possible extent, all equipment for the CPDF will be procured from commercial sources. Centrifuges will be procured from industry using government-supplied specifications and drawings. The existing Component Preparation Laboratory (CPL) located near the CPDF site will be used for centrifuge component receiving, inspection, assembly, and qualification testing of pre-production test machines. Later in the test program, samples of production machines planned for use in the GCEP will be tested in the CPDF.

34590 (K/TS—11-864) Definition and basis of a structural safety standard for AETF centrifuge mounting. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). May 1987. Contract AC05-84OT21400. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010075.

Document AEC-CP-15520 discusses the problems of defining a mount safety standard and ultimately recommends that UCC-ND and AiResearch generate such a standard for Set III machines. As both Set III machines will operate in the AETF Facility, we must have a minimum standard for design and evaluation for that facility. This document is created in response to that need. It represents a proposed standard to be applied to the AETF Facility, with an explanation of the basis for the standard.

34591 (K/TS—11-865) System design description for the CPDF [Centrifuge Plant Demonstration Facility] cascade process system: SDD-4. (Science Applications, Inc., Oak Ridge, TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 98p. NTIS MF A01; 2; GPO Dep. File Number DE87010965.

The Centrifuge Plant Demonstration Facility (CPDF) Cascade Process System is a network of pipes and valves that transforms a group of centrifuge machines into a cascade. It interfaces with the feed system, the withdrawal system, with every machine in the cascade, and with control mechanisms, including machine variables instrument packages (MVIP's), the cascade local computer (CLC), and the cascade control room (CCR) computer. Utilities required by the Cascade Process System are electricity and compressed air. A network of valves, including instrumentation, controls flow of feed, product, and tails on the machine and cascade levels. It also provides the means for recycling, isolating, and

dumping the inventory of individual machines or of the whole cascade.

34592 (K/TS—11-870) System design description for the CPDF [Centrifuge Plant Demonstration Facility] feed system: SDD-3. (Science Applications, Inc., Oak Ridge, TN (USA)). Jun 1987. Contract AC05-84OT21400. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011074.

The Centrifuge Plant Demonstration Facility (CPDF) Feed System provides a controlled flow of gaseous uranium hexafluoride (UF_6) to the centrifuge cascade at subatmospheric pressures. In performing this function, the Feed System receives cylinders of solid UF_6 and heats these cylinders in steam-heated, recirculating-air enclosures, which vaporizes the UF_6. Pressure-reducing valves and an orifice are included in the Feed System to ensure correct feed pressure and limit feed flow rate at the cascade interface. Feed enclosure operation instrumentation, cylinder temperature instrumentation, and feed line pressure instrumentation provide information necessary to permit local and cascade control room (CCR) control and monitoring of Feed System operation. In addition, alarms and automatic shutdown devices are provided for Feed System, cascade, operator, and environmental protection in the event of off-normal operation.

34593 (K/TS—11-871) Machine plumbness criteria: Interim technology release. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011075.

The objective of this technology release is to define the maximum allowable deviation from plumb of the centrifuge machine and to recommend machine installation techniques to achieve the specified criteria. The centrifuge feature used as a reference for plumbness is the casing centerline as defined by a line drawn between the theoretical centers of the top and bottom flange faces. In practice, this measurement is accomplished by using specified casing flange diameters or bolt patterns as the reference points. The criterion adopted for GCEP is that each machine shall be plumb within 0.5 in. over the length of the casing as initially installed. Over a long period of time the plumbness is allowed to degrade to 1.0 in. This standard should be achievable using the currently planned installation techniques and within a time limit consistent with GCEP operational objectives. For development testing, centrifuge machines are meticulously adjusted using a plumb bob to achieve a plumbness with 1/8 in. About one to two days are required to complete the installation. This level of effort is justified for a development machine especially where baseline data is being gathered. A more reasonable standard with a corresponding reduction in installation time is required for GCEP. The specified criteria of 0.5 in. maximum out-of-plumb at time of installation and 1.0 in., ultimate, are believed to be a reasonable compromise. Machine design features or operating modes that are dependent on vertical alignment were examined to assess the impact of the selected plumbness criteria. Machine performance and design requirements are defined in the applicable technology release documents.

34594 (K/TS—11-873) Uranium accumulation in CTF and ETF-II rotors. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010964.

In the expanding technology of uranium enrichment by gas centrifuge, efforts are being made to become more and more familar with the reactions taking place inside the rotor tube while the machine is operational. Inspection of the rotor after shutdown shows where uranium containing compounds are deposited. A study of these deposits from several ETF, CTF and CPL rotors has provided insight as to accumulation amounts, its composition and deposition parameters involved.

34595 (LA-UR—87-1576) Monitoring the enrichment of the UF_6 in the pipework of a gas centrifuge enrichment plant. Packer, T.W.; Close, D.A.; Pratt, J.C. (Los Alamos National Lab., NM (USA); UKAEA Atomic Energy Research Establishment, Harwell). 1987. Contract W-7405-ENG-36. 7p. (CONF-870519—7). NTIS, PC A02. File Number DE87010113.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

Research in the UK and the US has resulted in the development of a nondestructive assay instrument which can confirm the presence of low enriched uranium, on a rapid Go, No-Go basis, in cascade header pipework in the centrifuge enrichment plant at Capenhurst. The instrument is based on gamma-ray spectrometry and x-ray fluorescence analysis. It allows pipes, 120mm outer diameter, to be inspected in a total measurement time of approximately 30 minutes. This paper describes the techniques developed and includes the results obtained during a demonstration to, and preliminary in-plant measurements by, members of the IAEA and EURATOM Inspectorates at Capenhurst.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 34691, 34701, 34827, 36198

34596 (HEDL-SA—3638-VT) Pulsed magnetic welding. Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 20 Nov 1986. Contract AC06-76FF02170. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010220.

Solid state welding techniques are an alternative to fusion welding. Two solid state welding techniques are pulsed magnetic welding and explosive bonding. Both achieve bonds by impacting the metals to be joined at high velocity. Development of the pulsed magnetic welding process by Hanford Engineers for fuel fabrication may make this process useful for a variety of other applications. Hanford engineers have developed advanced equipment for pulsed magnetic welding and have defined conditions for reliably welding stainless steel fuel pins using this equipment.

34597 (LA—10990) The influence of plutonium concentration and solution flow rate on the effective capacity of macroporous anion exchange resin. Marsh, S.F.; Gallegos, T.D. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010770.

The principal aqueous process used to recover and purify plutonium at the Los Alamos Plutonium Facility is anion exchange in nitric acid. Previous studies with gel-type anion exchange resin have shown an inverse relationship between plutonium concentration in the feed solution and the optimum flow rate for this process. Because gel-type resin has been replaced with macroporous resin at Los Alamos, the relationship between plutonium concentration and solution flow rate was reexamined with the selected Lewatit MP-500-FK resin using solutions of plutonium in nitric acid and in nitric acid with high levels of added nitrate salts. Our results with this resin differ significantly from previous data obtained with gel-type resin. Flow-rate variation from 10 to 80 liters per hour had essentially no effect on the measured quantities of plutonium sorbed by the macroporous resin. However, the effect of plutonium concentration in the feed solutions was pronounced, as feed solutions that contained the highest concentrations of plutonium also produced the highest resin loadings. The most notable effect of high concentrations of dissolved nitrate salts in these solutions was an increased resin capacity for plutonium at low flow rates. 16 refs., 7 figs., 2 tabs.

34598 Fusion blanket and method for producing directly fabricable fissile fuel. Cheng, E.T. (to GA Technologies, Inc., San Diego, CA). US Patent 4,663,110. 5 May 1987. Filed date 21 May 1985. vp.

A method of making fuel elements is described for a fission reactor by breeding fissile fuel in a tritium breeding fusion reactor having a blanket with an enrichment section. The method comprises the following steps: incorporating particles of fertile material and particles of a thermal neutron absorber into the enrichment section in such proportion that the particles of fertile material make up less than 3% by volume of the enrichment section, the thermal neutron absorber functioning at least in part to suppress thermal fissioning of the bred fissile fuel, bombarding the particles with neutrons generated by fusion, and adding additional particles of the

thermal neutron absorber as the fissile material content of the enrichment section increases to continue to suppress thermal fissioning of the bred fissile fuel, removing the particles from the blanket after sufficient time that the fuel particles are enriched to about 4%, mixing the particles to compensate for nonuniformities in enrichment introduced as a function of location of particles within the enrichment section, and fabricating the particles to form at least one fuel element.

34599 **Preparation of nuclear fuel spheres by flotation-internal gelation.** Haas, P.A.; Fowler, V.L.; Lloyd, M.H. (to Dept. of Energy, Washington, DC). US Patent 4,663,093. 5 May 1987. Filed date 23 Dec 1985. vp.

An internal gelation process is described for the preparation of nuclear fuels, comprising: moving a volume of hot perchloroethylene through a trough; directing droplets of a nuclear fuel solution into the moving volume of hot perchloroethylene. The droplets of nuclear fuel solution gel to form gelled spheres while the droplets are floating on the surface of the moving volume of perchloroethylene; dropping the resultant gelled spheres into a vertical column of perchloroethylene, wherein the gelled spheres of nuclear fuel age as a floating bed in the vertical column; and separating the aged gelled spheres of nuclear fuel from the perchloroethylene.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 34651

34600 **(DP—1732) Recovery of plutonium from electrorefining anode heels at Savannah River.** Gray, J.H.; Gray, L.W.; Karraker, D.G. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010561.

In a joint effort, the Savannah River Laboratory (SRL), Savannah River Plant (SRP), and the Rocky Flats Plant (RFP) have developed two processes to recover plutonium from electrorefining anode heel residues. Aqueous dissolution of anode heel metal was demonstrated at SRL on a laboratory scale and on a larger pilot scale using either sulfamic acid or nitric acid-hydrazine-fluoride solutions. This direct anode heel metal dissolution requires the use of a geometrically favorable dissolver. The second process developed involves first diluting the plutonium in the anode heel residues by alloying with aluminum. The alloyed anode heel plutonium can then be dissolved using a nitric acid-fluoride-mercury(II) solution in large non-geometrically favorable equipment where nuclear safety is ensured by concentration control.

34601 **(DP—1735) Cleanup of 7.5% tributyl phosphate/n-paraffin solvent-extraction solvent.** Reif, D.J. (Savannah River Lab., Aiken, SC (USA)). Feb 1987. Contract AC09-76SR00001. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008556.

The HM process at the Savannah River Plant uses 7.5% tributyl phosphate in n-paraffin as an extraction solvent. During use, the solvent is altered due to hydrolysis and radiolysis, forming materials which influence product losses, product decontamination, and separation efficiencies. Laboratory studies to improve online solvent cleaning have shown that carbonate washing, although removing residual solvent activity, does not remove binding ligands which hold fission products in the solvent. Treatment of solvent by an alumina adsorption process removes binding ligands and significantly improves recycle solvent performance. Both laboratory work defining a full-scale alumina adsorption process and the use of the process to clean HM process first cycle solvent is discussed.

34602 **(DP—1744) Analysis of residual organic materials in aqueous radioactive streams from the Purex process.** Shook, H.E. Jr. (Savannah River Lab., Aiken, SC (USA)). May 1987. Contract AC09-76SR00001. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010562.

New solid phase extraction methods have been developed to allow determination of residual normal paraffin hydrocarbon (NPH) and tri-n-butyl phosphate (TBP) in aqueous radioactive streams from the Purex process. The techniques concentrate organic materials and separate them from radioactive species for analysis by gas chromatography. TBP and NPH have good radiolytic and chemical stability and have low aqueous solubility. However, they can contaminate aqueous streams and cause processing difficulties. Knowledge of the concentration of organic materials in aqueous waste is useful in assessing impact on pollution control equipment. The storage quality of diluent-washed aqueous plutonium product solution can be determined by a gas chromatographic analysis for residual TBP. 4 refs., 1 fig., 7 tabs.

34603 **(LA—10907) Chemical treatment of plutonium with hydrogen peroxide before nitrate anion exchange processing.** Marsh, S.F.; Gallegos, T.D. (Los Alamos National Lab., NM (USA)). May 1987. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010828.

The major aqueous process used to recover and purify plutonium at the Los Alamos Plutonium Facility is anion exchange in nitric acid. This process is highly selective for plutonium; however, all plutonium must be as Pu(IV) to form the strongly sorbed anionic nitrato complex. The previous "full-reduction treatment" used at Los Alamos to obtain Pu(IV) results in a three- to fourfold increase in the feed solution volume and the introduction of kilogram quantities of extraneous salts immediately before a process whose function is to remove such impurities. That treatment has been successfully replaced by a single reagent, hydrogen peroxide, which converts all plutonium to Pu(IV), minimally increases the feed volume, and introduces no residual impurities. Safety aspects of this revised chemical treatment are addressed.

34604 **(LA—10921) Plutonium process control using an advanced on-line gamma monitor for uranium, plutonium, and americium.** Marsh, S.F.; Miller, M.C. (Los Alamos National Lab., NM (USA)). May 1987. Contract W-7405-ENG-36. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010829.

An on-line gamma monitor has been developed to profile uranium, plutonium, and americium in waste and product streams of the anion exchange process used to recover and purify plutonium at the Los Alamos Plutonium Facility. The gamma monitor employs passive gamma spectrometry to measure ^{241}Am and ^{239}Pu, based on their 59.5-keV and 129-keV gamma rays, respectively. Because natural and depleted uranium present in typical process streams have no gamma rays suitable for measurement by such passive methods, uranium measurement requires a novel and less direct technique. Plutonium-241, which is always present in plutonium processed at Los Alamos, decays primarily by beta emission to form ^{241}Am. However, a small fraction of ^{241}Pu decays by alpha emission to 6.8-day ^{237}U. The short half-life and 208-keV gamma energy of ^{237}U make it an ideal radiotracer to mark the position of macro amounts of uranium impurity in the separation process. The real-time data obtained from an operating process allow operators to optimize many process parameters. The gamma monitor also provides a permanent record of the daily performance of each ion exchange system. 2 refs., 12 figs.

34605 **(LA—10975) An improved, computer-based, on-line gamma monitor for plutonium anion exchange process control.** Pope, N.G.; Marsh, S.F. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010834.

An improved, low-cost, computer-based system has replaced a previously developed on-line gamma monitor. Both instruments continuously profile uranium, plutonium, and americium in the nitrate anion exchange process used to recover and purify plutonium at the Los Alamos Plutonium Facility. The latest system incorporates a personal computer that provides full-feature multichannel analyzer (MCA) capabilities by means of a single-slot, plug-in integrated circuit board. In addition to controlling all MCA functions, the computer program continuously corrects for gain shift and performs all other data processing functions. This Plutonium Recovery Operations Gamma Ray Energy Spectrometer System (PROGRESS) provides on-line process operational data essential for efficient operation. By identifying abnormal conditions in real time, it allows operators to take corrective actions promptly. The decision-making capability of the computer will be of increasing

value as we implement automated process-control functions in the future. 4 refs., 6 figs.

34606 **(ORNL/TM—10303) Evaluation of high-definition television for remote task performance.** Draper, J.V.; Fujita, Y.; Herndon, J.N. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87009784.

High-definition television (HDTV) transmits a video image with more than twice the number (1125 for HDTV to 525 for standard-resolution TV) of horizontal scan lines that standard-resolution TV provides. The improvement in picture quality (compared to standard-resolution TV) that the extra scan lines provide is impressive. Objects in the HDTV picture have more sharply defined edges, better contrast, and more accurate reproduction of shading and color patterns than do those in the standard-resolution TV picture. Because the TV viewing system is a key component for teleoperator performance, an improvement in TV picture quality could mean an improvement in the speed and accuracy with which teleoperators perform tasks. This report describes three experiments designed to evaluate the impact of HDTV on the performance of typical remote tasks. The performance of HDTV was compared to that of standard-resolution, monochromatic TV and standard-resolution, stereoscopic, monochromatic TV in the context of judgment of depth in a televised scene, visual inspection of an object, and performance of a typical remote handling task. The results of the three experiments show that in some areas HDTV can lead to improvement in teleoperator performance. Observers inspecting a small object for a flaw were more accurate with HDTV than with either of the standard-resolution systems. High resolution is critical for detection of small-scale flaws of the type in the experiment (a scratch on a glass bottle). These experiments provided an evaluation of HDTV television for use in tasks that must be routinely performed to remotely maintain a nuclear fuel reprocessing facility. 5 refs., 7 figs., 9 tabs.

34607 **The FRG-US workshop on near-real-time accounting for reprocessing plants.** Weh, R.; Hakkila, E.A.; Canty, M.J. (Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen mbH, Hannover). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 2, 12-16(Jan 1987).

A technical workshop on the subject of near-real-time material accounting in an industrial scale reprocessing plant was held in Hannover from May 5 to 7, 1986. Organized within the context of the US DOE - FRG-BMFT agreement in the field of international safeguards, the workshop was initiated by the Deutsche Gesellschaft fur Wiederaufarbeitung von Kernbrennstoffen, responsible for the construction and operation of a planned industrial scale reprocessing plant in the Federal Republic of Germany. The workshop's objective was to establish the current state of the art for near-real-time accounting and to bring about a common understanding and consensus among experts from both countries to serve as a basis for the definition of problems still to be solved. A summary of the workshop presentations, preliminary conclusions drawn by the experts attending as well as some implications for the application of dynamic balancing is given.

34608 **Sequential analysis of materials balances.** Picard, R.R. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 2, 38-42(Jan 1987).

This paper discusses sequential procedures for near-real-time accounting, using the prospective DWK reprocessing plant at Wackersdorf for illustration. Sensitivity of a standard sequential testing procedure is examined with respect to a variety of loss scenarios. It is seen that large inventories can preclude high-probability detection of certain protracted losses of material. Mathematical development for the analysis is introduced. Generic aspects of sequential testing are reviewed with emphasis on philosophical issues. A rough error propagation for the materials balance area (MBA) of interest is outlined, and results from a simulation to quantify performance of the accounting system are presented.

34609 **IAEA verification of materials accounting in commercial reprocessing plants.** Gutmacher, R.G.; Hakkila, E.A. (Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 2, 43-47(Jan 1987).

The reprocessing plants currently under International Atomic Energy Agency (IAEA) safeguards have design capacities up to 210 tonnes of heavy metal per year. All of the plants use conventional materials accounting for safeguards. However, several larger commercial reprocessing plants are being designed with capacities of 350 to 1200 tonnes of heavy metal per year. It is likely that many of these plants, as well as some of the existing smaller ones, will adopt near-real-time materials accounting. The major effect of the combination of larger plants and near-real-time accounting on IAEA safeguards will be the demand for greater timeliness of verification. Continuous inspector presence may be required, as well as more on-site measurements by the inspector. In this paper, the authors review what needs to be verified, as well as current inspector activities in the process area. The bulk of the paper describes rapid, easy-to-use measurement techniques and instruments that may be applied to on-site verification measurements.

34610 **Electrolytic dissolution experience at the Idaho Chemical Processing Plant.** Dukas, S.J.; Black, D.M.; McClure, L.W.; Offutt, G.F. New York, NY; American Institute of Chemical Engineers (1986). 29p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC07-84ID12435.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Following considerable development work at the Idaho Chemical Processing Plant (ICPP) and other fuel processing sites, a production scale Electrolytic Dissolution process was installed in 1970. Since that time several processing campaigns have been completed using stainless steel-clad EBR-II fuel as feed. Approximately 4350 kgs of total uranium have been charged to the Electrolytic Dissolution System to date. The capability to electrolytically dissolve aluminum-clad fuels in the future is presently being developed.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 34667

34611 **(CONF-870245—, pp 67-83) Risks of transportation of radioactive and hazardous wastes.** Rhyne, W.R. (H & R Technical Associates, Inc., Oak Ridge, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The evaluation of transportation risks follows the same procedure as many other probabilistic risk analysis; the general procedure consists of five basic steps: (1) potential accident scenarios are identified, (2) probabilities or frequencies are assigned to the elements of the accident scenarios, (3) consequences of each scenario, e.g., fatalities, are determined. (4) uncertainties and sensitivities are evaluated, and (5) results are presented in a readily understandable format. Each of these steps can be performed in various levels of detail and using different techniques.

34612 **(EPRI-NP—5174) NUHOMS spent-fuel storage demonstration: Program overview.** (Carolina Power and Light Co., Raleigh, NC (USA); Nutech Engineers, Inc., San Jose, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA); Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 49p. (PNL—6183). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008527.

Carolina Power & Light, the US Department of Energy and EPRI are participating in a cooperative program to demonstrate the NUHOMS (NUTECH Horizontal Modular Storage) system for storing spent nuclear fuel. This technology was developed by NUTECH Engineers, who are also participating in the project. The project involves the design, construction and testing of three modules at the H.B. Robinson Plant. Testing will be focused on (1) the

system's operating and fuel handling features and (2) confirmation of the thermal and shielding performance of the storage modules. As part of the project, NRC approval of the NUTECH Topical Report on NUHOMS will be obtained as well as issuance of a storage license for the Robinson site. 24 refs., 6 figs., 8 tabs.

34613 **(PNL—6002) FACSIM/MRS-1: Cask receiving and consolidation performance assessment.** Lotz, T.L.; Shay, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 550p. NTIS, PC A23. File Number DE87011105.

A simulation analysis was completed to assess the performance of the shipping cask receiving and spent-fuel handling, consolidation and canistering operations of the Monitored Retrievable Storage (MRS) facility. One purpose of this evaluation was to estimate the limits of MRS operational capabilities and factors leading to those limitations. The model used to obtain the performance assessment, FACSIM/MRS-1, is one of two components of the FACSIM model developed by PNL's simulation effort for the nuclear waste-handling facility. FACSIM/MRS-1 provides the user with information about lag-storage requirements, machine use, cask queues, welder queues, and cask process and cask turnaround times. The model can help determine the effect that the following activities have on operating efficiency: (1) receiving multiple cask shipments, when rail-cask or truck-cask shipments arrive at the facility in groups of two or more, and (2) operating the facility five days per week, three shifts per day or seven days per week, three shifts per day for any conditions. In addition, sensitivity to equipment failure frequency and the time needed for equipment repair can be studied. Information on the above operating characteristics may be obtained for any spent-fuel rate, any split of shipments between truck and rail transport, or any split of boiling water reactor/pressurized water reactor fuel.

34614 **(PNL—6104) Reactor-specific spent fuel discharge projections: 1986 to 2020.** Heeb, C.M.; Walling, R.C.; Purcell, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87008397.

The creation of five reactor-specific spent fuel data bases that contain information on the projected amounts of spent fuel to be discharged from US commercial nuclear reactors through the year 2020 is described. The data bases contain detailed spent-fuel information from existing, planned, and projected pressurized water reactors (PWR) and boiling water reactors (BWR). The projections are based on individual reactor information supplied by the US reactor owners. The basic information is adjusted to conform to Energy Information Agency (EIA) forecasts for nuclear installed capacity, generation, and spent fuel discharged. The EIA cases considered are: (1) No new orders with extended burnup, (2) No new orders with constant burnup, (3) Upper reference (which assumes extended burnup), (4) Upper reference with constant burnup, and (5) Lower reference (which assumes extended burnup). Detailed, by-reactor tables are provided for annual discharged amounts of spent fuel, for storage requirements assuming maximum-at-reactor storage, and for storage requirements assuming maximum-at-reactor plus intra-utility transshipment of spent fuel. 6 refs., 8 figs., 8 tabs.

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REFER ALSO TO CITATION(S) 34613, 34687, 35135, 35136, 35353, 35358, 35711, 35740, 35893

34615 **(AI-DOE—13559) Nuclear Materials Development Facility decommissioning final report.** Frazier, R.J.; Harrison, D.J.; Meyer, R.D.; Schrag, F.C.; Wilson, R.C. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). 31 Mar 1987. Contract AC03-81SF11565. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010784.

The Nuclear Materials Development Facility (NMDF), building 055, was utilized for research, development, and production work on radiotoxic nuclear fuels, primarily ^{239}Pu. The decision was made in FY 1982 to decommission the facility as part of the Department of Energy's (DOE's) Surplus Facilities Management Program. The intent was to decontaminate and decommission (D and D) the NMDF to the extent it would be suitable for unrestricted use. A project plan was prepared to describe the scope of the work, the techniques used, and the equipment needed for D and D. Activity requirements and detailed work procedures were prepared to define the work required on each major segment of the decommissioning. A facility description, history, and the special techniques used during D and D are given in this report. The more significant D and D activities, which include glovebox decontamination, support area contamination, and HVAC decontamination, are summarized in this document. The NMDF was decontaminated to levels that were as low as reasonably achievable (ALARA), but in all cases to levels below the limits prescribed for unrestricted use. The disposal of potentially contaminated NaK, contained in 10 bubblers that were used to purify the inert atmosphere of the glove boxes, also is discussed. The decommissioning of Rockwell's NMDF began in October 1982 and was completed in October 1986. Final surveys, waste shipments, and the final report were completed by March 1987. The final schedule for the project is shown in Section 5.0 (Figure 46). 48 figs., 8 tabs.

34616 **(ANL/EES-TM—333) Radioactive Waste Isolation in Salt: Peer review of documents dealing with geophysical investigations.** McGinnis, L.D.; Bowen, R.H. (Argonne National Lab., IL (USA)). Mar 1987. Contract W-31109-ENG-38. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010334.

The Salt Repository Project, a US Department of Energy program to develop a mined repository in salt for high-level radioactive waste, is governed by a complex and sometimes inconsistent array of laws, administrative regulations, guidelines, and position papers. In conducting multidisciplinary peer reviews of contractor documents in support of this project, Argonne National Laboratory has needed to inform its expert reviewers of these governmental mandates, with particular emphasis on the relationship between issues and the technical work undertaken. This report acquaints peer review panelists with the regulatory framework as it affects their reviews of site characterization plans and related documents, including surface-based and underground test plans. Panelists will be asked to consider repository performance objectives and issues as they judge the adequacy of proposed geophysical testing. All site-specific discussions relate to the Deaf Smith County site in Texas, which was approved for site characterization by the President in May 1986. Natural processes active at the Deaf Smith County site and the status of geophysical testing near the site are reviewed briefly. 25 refs., 4 figs., 5 tabs.

34617 **(BMI/ONWI—530) Heat transfer within spent fuel canisters: Phase two of an experimental laboratory study.** Keyhani, M.; Kulacki, F.A.; Christensen, R.N. (Ohio State Univ., Columbus (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Apr 1987. Contract AC02-83CH10140. 207p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87011007.

The primary goal of this research was to develop a generalized correlation for convective heat transfer coefficients in rod bundles such as those encountered in the storage and disposal of spent nuclear fuel. The results of the study provide data relevant to design and performance assessment of spent fuel packages as part of the Civilian Radioactive Waste Management Program. In a series of laboratory experiments, heat transfer and temperature distributions were measured in a vertical annulus, and in 3 x 3 and 5 x 5 vertical rod bundles. A correlation was developed relating Nusselt numbers to Rayleigh numbers, radius ratios, aspect ratios, and pitch-to-diameter ratios. In the annulus experiments with a fixed Rayleigh number, an increase in the Prandtl number resulted in a reduction in the Nusselt number. This is inconsistent with findings that have been reported for vertical cavities, and was attributed to curvature effects. The effect of the Prandtl number in the vertical rod bundle experiments was similar to that in the annulus case. Application of a generalized heat transfer correlation to a pressurized-water-reactor fuel-rod bundle predicted maximum rod temperature to within 4 to 14% of results obtained in field tests with a full-scale fuel-rod bundle of 15 x 15 rods. 32 refs., 51 figs., 4 tabs.

34618 **(BMI/ONWI—642) Multifactor test design to investigate uniform corrosion of low-carbon steel in a nuclear waste salt repository environment.** Gopal, S.; Ballinger, R.; Cunnane, J.; Kuhn, W.; Lee, B.; Moran, P.;Westerman, R. (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). Jun 1987. Contract AC02-83CH10140. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011234.

The Salt Repository Project Panel on the Experimental Design for the Uniform Corrosion of Low-Carbon Steel was convened to develop a well-documented consensus test matrix. A multidisciplinary panel of seven scientists and engineers have recommended a full factorial matrix of 250 tests with 4 experimental factors: time, temperature, oxygen fugacity, and magnesium concentration. The panel also recommended 31 supplementary tests to study the effects of other factors. Because of the large number of tests involved, the panel recommended a stepwise implementation starting with 78 tests at various combinations of time, temperature, magnesium concentration, and oxygen fugacity. When the test results become available, they should be analyzed to determine future test needs.

34619 **(BMU—1986-108) Thermomechanical calculations in the near field of HAW waste forms.** Baltes, B.; Mohiuddin, G.M. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 36p. (In German). (GRS-A—1224). NTIS, PC E07; Available from NTIS as TIB/B87-00421.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Thermomechanical calculations in the near field of HAW-canisters of a rock salt repository show that the borehole converges as a function of temperature and pressure distribution around the borehole. Due to the convergence of rock salt free space will reduce and closes the gap between borehole and canister. The gap dosure starts at the bottom of the 300 m deep borehole 214 day after disposal. This process of gap closure proceeds upwards the column of canisters and ends about 90 days later reaching the top of the column. In addition of these results the calculations show a strong radial temperature gradients as well as the pressure increase near the borehole after gap closure.

34620 (CONF-870245—, pp 7-11) **Oak Ridge Model for waste management.** Bibb, W.R. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The Oak Ridge Model is a concept addressing waste disposal problems at facilities administered by the US Department of Energy's Oak Ridge Operations office. The model concept used DOE facilities as laboratories to develop and/or demonstrate technology for cleaning up environmental problems caused by radioactive and hazardous wastes which can be applied to problems at Oak Ridge facilities as well as facilities throughout the US. Working with regulators, private industry, universities, and contractors, DOE/ORO is taking decisive steps via the Oak Ridge Model to develop solutions to waste management problems. The model is based on three philosophical precepts: A need exists to provide a mechanism to demonstrate acceptable solutions to waste problems. All available resources should be used to help solve the problems, and A continuous exchange of information among the partners involved is necessary. The framework encompasses research, development, and demonstration; regulator interface; technical interface and technology transfer; and public information. The goal is to solve problems at Oak Ridge facilities but in the process develop commercially available technologies which can be used to solve similar problems at other sites.

34621 (CONF-870245—, pp 17-28) **Overview of the Martin Marietta Energy Systems Waste Management Technology Center.** Genung, R.K. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The role of the Waste Management Technology Center is to: provide technical analyses to support the development of corporate waste management policies by Martin Marietta Energy Systems and DOE/ORO; involve the private sector in the identification and demonstration of innovative technologies; assist in obtaining regulator approval for the implementation of new waste management practices; and to assist in the deployment of new waste management systems on DOE/ORO sites. Major program responsibilities assigned to the WMTC are: development of new low-level waste disposal facilities for the Oak Ridge Reservation Low-Level Waste Disposal Development Demonstration (LLWDDD) program; and coordination of hazardous waste treatment demonstrations conducted on ORO-managed sites under DOE's National Hazardous Wastes Remedial Action Program (HAZWRAP).

34622 (CONF-870245—, pp 39-43) **Role of the public in the Oak Ridge Model.** Davis, G.A. (Legal Environmental Assistance Foundation, Knoxville, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The role of the public in relation to the Oak Ridge Model and waste management practices in Oak Ridge, Tennessee are discussed. The public outrage at high mercury spills first focused public concern on improper management practices at the Y-12 plant and other facilities on the Oak Ridge reservation. The Oak Ridge Environmental Advisory Committee is one way that the public has been involved and continues to be involved in the Oak Ridge Model. The purpose of the committee is to have an independent scientific peer review group with participation from community residents to provide advice and assist DOE on upgrading waste management practices at the Oak Ridge reservation.

34623 (CONF-870245—, pp 46-57) **Trends in the management of mixed and hazardous wastes.** Coffman, F.E. (International Technology Corp., Knoxville, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Mixed wastes include hazardous as well as radioactive wastes. The factors driving mixed waste management and the changing industry practices involving mixed wastes are presented. The evolution of the waste management program is discussed. Attention is focused on DOE environmental programs.

34624 (CONF-870245—, pp 61-64) **Standards for remedial action: how clean is clean?.** Sharples, F.E. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Standards for remedial actions at hazardous waste sites may be derived from either the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the Resource Conservation and Recovery Act (RCRA) and their related regulations. At the moment, it may be unclear whether regulators intend to apply one statute or the other, or both, in regard to selecting remedial actions and cleanup criteria for particular sites. It is therefore necessary to describe in general terms the different approaches to determining cleanup standards under the two statutes.

34625 (CONF-870245—, pp 87-120) **Role of engineered features in enhancing site performance.** Homan, F.J. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A summary is presented of solid low-level wastes generated at ORNL and the strategy for managing these wastes is described. Data concerning radionuclide release from solid waste storage area 6 are tabulated. Past practices involving low-level wastes are discussed including a chronology of the changes that have taken place. Engineered disposal units that are now in use are described.

34626 (CONF-870245—, pp 129-138) **Fact sheet Oak Ridge Model conference tour, February 4, 1987.** 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Waste-management facilities at all three major Oak Ridge production and research facilities operated by Martin Marietta Energy Systems, Inc., for the Department of Energy - the Y-12 Plant, Oak Ridge Gaseous Diffusion Plant, and Oak Ridge National Laboratory are discussed. They are as follows: Y-12 - S-3 Ponds, West End Treatment Facility Bear Creek Burial Ground; ORGDP - Toxic Substances Control Act (TSCA) Incinerator Sludge Fixation Facility Interim Waste Storage (K-25 Building); ORNL - Solid Low-Level-Waste Greater Confinement Disposal Tumulus Demonstration Site TRU Waste, Waste Compaction Facilities. Background on past and present missions of the the Oak Ridge facilities is presented.

34627 (CONF-870245—, pp 157-176) **Review of alternatives for closure of burial ground C-404.** Dierolf, D.K. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Burial ground C-404 at the Paducah Gaseous Diffusion Plant was found to be in noncompliance with the Resource Conservation and Recovery Act as a hazardous waste landfill. The problems encountered and the alternatives for closure of the burial ground are evaluated. In addition, the steps involved in the decision-making process are analyzed.

34628 (CONF-870245—, pp 179-197) **Niagara Falls Storage Site and its relevance to remedial action at the Oak Ridge reservation.** Coxon, G.D.; Nemec, J.F.; Hoffman, J.M. (Bechtel National, Inc., Oak Ridge, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The Niagara Falls Storage Site, near Lewiston, New York, is a DOE storage site for low-level radioactive waste. Remedial action has been completed on the 250,000 yd^3 interim waste containment facility. During the course of the remedial action, several buildings were demolished and others decontaminated. Radioactively contaminated soil was removed from more than two dozen vicinity properties, as well as from large areas of the site itself. Fourteen million gallons of water were treated for release. This paper describes the remedial action project. It also provides additional detail on several aspects of the work from which useful insights can be gained for use in future projects of a similar nature: the design of the facility, the hydraulic mining of residues from a 165-ft-high tower, treatment of radioactively and chemically contaminated water, environmental monitoring, personnel monitoring, and unique post-closure monitoring of the containment facility.

34629 (CONF-870245—, pp 249-257) **Interim storage of low-level waste and the low-level waste demonstration program.** Emmett, R.W. (H & R Technical Associates, Oak Ridge, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A facility for interim storage of low-level waste (LLW) and mixed waste has been established at the Oak Ridge Gaseous Diffusion Plant (ORGDP). A portion of the lower level of the K-25 building has been designated for interim storage. Solid LLW and mixed waste will be stored in DOT Type A and strong, tight containers. A safety assessment of the packaging, transport, and storage of the wastes concluded that the radiological risk of these activities would be very small. A demonstration program is being developed to support the interim storage program at ORGDP. The demonstration program will investigate and evaluate technologies for interim storage and support interim storage operations.

34630 (CONF-870245—, pp 261-271) **SWSA 6 tumulus disposal demonstration.** Van Hoesen, S.D.; Clapp, R.B. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A facility to demonstrate the above-grade disposal of solid low-level radioactive wastes (LLW) is being constructed in the Solid Waste Storage Area 6 (SWSA 6) at the Oak Ridge National Laboratory (ORNL). The demonstration facility will utilize the Tumulus technology, which basically involves sealing the waste in concrete vaults, placing the vaults on a grade level concrete pad, and covering the pad with a soil cover after vault placement is complete. Loading of the demonstration unit is scheduled to begin in June, and will continue one to one and a half years until the 28,000 ft^3 capacity is exhausted.

34631 (CONF-870245—, pp 275-294) **Design and construction of an improved LLW disposal trench at the Maxey Flats Radioactive Waste Disposal Sites.** Razor, J.E.; Mills, D. (Westinghouse Electric Corp., Morehead, KY). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

This paper will describe the design and construction of an improved disposal trench site in a humid environment and in a fractured geologic media. The primary focus of the design development was on water management and long term trench stability. This disposal trench was constructed at the Maxey Flats Radioactive Waste Disposal Site under a demonstration project jointly funded by the US Department of Energy and the Commonwealth of Kentucky. Key elements of the paper include discussion of design criteria, design components, interaction of design components, trench construction, component costs, and performance monitoring.

34632 (CONF-870245—, pp 297-314) **Overview of the West Valley engineered waste management system.** Swenson, C. (West Valley Nuclear Services Co., NY). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A commercial reprocessing plant was operated at West Valley, New York from 1966-1972 and reprocessed 640 tons of spent fuel. That activity resulted in the production of approximately 2200 cubic meters of high-level waste which is stored in underground tanks. The systems and facilities that were designed, constructed, and put into operation to decontaminate and decommission the facility are discussed.

34633 (CONF-870245—, pp 316-331) **Start-up and operation of the biodenitrification demonstration facility at the FMPC.** Hopper, J.P.; Patton, J.B. (Westinghouse Materials Co. of Ohio, Cincinnati). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Topics of discussion include: site and process background; start-up coordination and demonstration progress. A schematic diagram of the FMPC process is included. Demonstration objectives are to verify fluid bed technology, to assess denitrifying performance, to evaluate upset conditions and to evaluate the effects on the sewage treatment plant.

34634 (CONF-870245—, pp 337-349) **Pilot plant operation of the Uranium Chip Oxidation Facility at the Oak Ridge Y-12 plant.** Childs, Y.C. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A method was devised by the Y-12 Plant Development Division that would eliminate uranium chip burial and minimize storage space requirements. The proposed method of accomplishing this task was oxidizing the uranium chips to uranium oxide under controlled conditions. Construction of the Uranium Chip Oxidation Facility began in December 1984 and pilot plant operation of the facility was initiated in May 1985. Operation of the facility is described and recommendations concerning the operation are presented.

34635 (CONF-870245—, pp 353-359) **Giving radwaste its due - integration of facility waste and housekeeping responsibilities.** Thiesing, J.W. (Bechtel National, Inc., Oak Ridge, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A solution which has been recently implemented at several operating nuclear power facilities is to eliminate the priority problems and competition for resources which have plagued efforts at controlling radwaste by establishing an organization whose mission is to minimize radwaste, see to its expeditious handling, packaging and disposal, address contamination problems quickly, and maintain the facility in a high state of radiological and physical cleanliness. The radwaste operations support group (ROSG) as it is called, has been established at operating nuclear power plants to address, as its sole mission, problems related to solid radwaste handling, facility decontamination and facility housekeeping. The radwaste operations group is administratively prohibited from participating in activities outside this rather narrow mission. In this way, its resources cannot be diverted to higher priority plant problems and its performance measurement objectives are strictly limited to radwaste processing, handling, and minimization, and the overall radiological and physical housekeeping of the plant. Though such an approach might be viewed as creating an additional empire with its additional costs, it has been shown to be the only effective means of focusing proper attention on the management of the waste products at these facilities.

34636 (CONF-870245—, pp 363) **Benefits and economics of volume-reducing low level waste.** Arrowsmith, H.W.; Skvara, D.E. (Scientific Ecology Group, Oak Ridge, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Scientific Ecology Group, Inc., has completed the installation, and is now operating a unique, $6 million state-of-the art Central Volume Reduction Facility (CVRF) capable of processing more than 1,500,000 cubic feet of waste per year. Since becoming operational in October 1986, more than 30,000 cubic feet of commercial, low-level radioactive waste (LLRW) has been processed and shipped to the burial grounds in Nevada, South Carolina, and Washington. The purpose of the CVRF is to process LLRW in manner which will ultimately reduce disposal costs to the waste generator and improve the environmental performance of the waste form after burial. Various techniques are used to accomplish these objectives including: sorting to remove the mixed waste and non-waste valuable materials from the waste stream; volume reduction by supercompaction and other methods; and the fabrication of LLWR burial modules.

34637 (CONF-870245—, pp 407-428) **ORGDP RCRA/PCB incinerator facility.** Rogers, T. (Oak Ridge Gaseous Diffusion Plant). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

A dual purpose solid/liquid incinerator is currently being constructed at the Oak Ridge Gaseous Diffusion Plant [ORGDP (K-25)] to destroy uranium contaminated, hazardous organic wastes in compliance with the Toxic Substances Control Act (TSCA) and the Resource Conservation and Recovery Act (RCRA). These wastes are generated by the gaseous diffusion plants in Oak Ridge, TN; Paducah, KY; and Portsmouth, OH. In addition, waste will also be received from the Y-12 Plant, Oak Ridge National Laboratory (ORNL), and the Feed Materials Production Center (FMPC). Destruction of PCBs and hazardous liquid organic wastes will be accomplished in a rotary kiln incinerator with an afterburner. This system was selected faster a study of various alternatives. Incineration was chosen because it is dependable, permanent, detoxifies organics, and reduces volume. The rotary kiln incinerator was selected because it can thermally destroy organic constituents of liquids, solids, and sludges to produce an organically inert ash. In addition to the incineration off-gas treatment system, the facility includes a tank farm, drum storage buildings, a solids preparation area, a control room, and a data management system. The incineration system, off-gas treatment system, and related instrumentation and controls are being provided by International Waste Energy Systems (IWES) which is responsible for design, construction, startup, and performances testing.

34638 (CONF-870557—1-Vugraphs) **Case history: Radioactive lead waste in USDOE facilities.** Homan, F.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009025.

From Executive conference on low-level and mixed waste disposal: the public and the science; Bethesda, MD, USA (3 May 1987).

Since lead is regarded as a hazardous material, the disposal or decontamination of large quantities of contaminated shielding material creates a problem. Permit applications are required. This problem is considered from the point of view of several US DOE sites. Viewgraphs from the presentation are included. (LTN)

34639 (CONF-870601—11) **ORIGEN-S (α,n) neutron source spectra in borosilicate glass containing HLW [high-level waste].** Hermann, O.W.; Parks, C.V.; Ludwig, S.B. (Oak Ridge National Lab., TN (USA); Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1987. Contract AC05-84OR21400. 7p. NTIS MF A01; 2; GPO Dep. File Number DE87005692.

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

There is growing interest in the methodology and computational software for evaluating the (α,n) source spectra produced in mixtures of high-level waste (HLW) and borosilicate glass. The need for this development has been seen in previous work involving the analysis of HLW in borosilicate glass. Descriptions and applications of the ORIGEN-S method of computing neutron source spectra by both (α,n) reactions and spontaneous fission of UO_2 spent fuel have been reported previously. This summary presents a significant expansion of the ORIGEN-S (α,n) model to include α-interactions with the light elements of borosilicate glass.

34640 (DOE/CH/10140—03-86-4) **Salt repository project: Technical progress report for the quarter 1 July-30 September, 1986.** (Battelle Memorial Inst., Columbus, OH (USA). Office of Nuclear Waste Isolation). 1986. Contract AC02-83CH10140. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87007366.

This document reports the progress being made each quarter on the development of a geologic repository in salt for the permanent disposal of high-level nuclear waste. The reporting elements are arranged by the work breakdown structure so that related studies are presented together. The studies are reported by the Office of Nuclear Waste Isolation, a prime contractor of the US Department of Energy (DOE) Salt Repository Project Office. The studies include work by other DOE prime contractors and by contractors to the Office of Nuclear Waste Isolation.

34641 (DOE/DP—0042) **Program Implementation Plan.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Defense Waste and Transportation Management). Jun 1987. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011604.

The Program Implementation Plan (PIP) describes the US Department of Energy's (DOE's) current approaches for managing the permanent disposal of defense high-level waste (HLW), transuranic (TRU) waste, and low-level waste (LLW) from atomic energy defense activities. It documents the implementation of the HLW and TRU waste policies as stated in the Defense Waste Management Plan (DWMP) (DOE/DP-0015), dated June 1983, and also addresses the management of LLW. The narrative reflects both accomplishments and changes in the scope of activities. All cost tables and milestone schedules are current as of January 1987. The goals of the program, to provide safe processing and utilization, storage, and disposal of DOE radioactive waste and byproducts to support defense nuclear materials production activities, and to implement cost-effective improvements in all of its ongoing and planned activities, have not changed.

34642 (DOE/LLW—13Th) Low-level radioactive waste management handbook series: Low-level radioactive waste management in medical and biomedical research institutions. (California Univ., Irvine (USA)). Mar 1987. Contract AC07-76ID01570. 248p. NTIS, PC A11. File Number DE87009729.

Development of this handbook began in 1982 at the request of the Radhealth Branch of the California Department of Health Services. California Assembly Bill 1513 directed the DHS to "evaluate the technical and economic feasibility of (1) reducing the volume, reactivity, and chemical and radioactive hazard of (low-level radioactive) waste and (2) substituting nonradioactive or short-lived radioactive materials for those radionuclides which require long-term isolation from the environment. A contract awarded to the University of California at Irvine-UCI (California Std. Agreement 79902), to develop a document focusing on methods for decreasing low-level radioactive waste (LLW) generation in institutions was a result of that directive. In early 1985, the US Department of Energy, through EG & G Idaho, Inc., contracted with UCI to expand, update, and revise the California text for national release.

34643 (DOE/NE/44139—16) West Valley Demonstration Project low-level and transuranic waste assay and methodology. McVay, C.W. (West Valley Nuclear Services Co., Inc., West Valley, NY (USA)). Mar 1987. Contract AC07-81NE44139. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011873.

In the decontamination and decommissioning of the West Valley Nuclear Facility, waste materials are being removed and packaged in a variety of waste containers which require classification in accordance with USNRC 10 CFR 61 and DOE 5820.2 criteria. Low-Level and Transuranic waste assay systems have been developed to efficiently assay and classify the waste packages. The waste is assayed by segmented gamma scanning, passive neutron techniques, dose rate conversion, and/or radiochemical laboratory analysis. The systems are capable of handling all the waste forms currently packaged as part of the Project. The above systems produce a list of nuclides present with their concentrations and determines the classification of the waste packages based on criteria outlined in DOE Order 5820.2 and USNRC 10 CFR 61.55. 9 refs., 12 figs., 8 tabs.

34644 (DOE/NV/10322—17) NNWSI hole histories: USW VH-1, USW VH-2. (Fenix and Scisson, Inc., Mercury, NV (USA)). Dec 1986. Contract AC08-84NV10322. 56p. NTIS, PC E07/MF $9.95; GPO Dep. File Number DE87011057.

Includes 16 sheets of 24x reduction microfiche.

This report is a compilation of data from two boreholes drilled within the Bureau of Land Management (BLM) lands adjacent to the Nevada Test Site (NTS). The boreholes were drilled to obtain hydrologic, geologic, geophysical data to help determine the volcanic eruption rate in Crater Flat, the aeromagnetic anomalies east of Red and Black volcanic cones, and to help define the rate of vertical tectonism in western Crater Flat. Data presented in this publication include locations, daily activities, reviews of hole condition, geophysical log listings, video tape listings, and microfiche copies of all geophysical logs run by the Fenix and Scisson (F and S) subcontractors.

34645 (DOE/OR/00033—T311) Numerical computations of natural convection heat transfer in irregular geometries: Final technical report. Glakpe, E.K. (Howard Univ., Washington, DC (USA)). 23 Jan 1987. Contract AC05-76OR00033. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87009957.

The goal of the research program at Howard University is to develop ad document a general purpose computer code that can be used to obtain flow and heat transfer data for the transport or storage of spent fuel configurations. We believe that this work is relevant to DOE/OCRWM storage and transportation programs for the protection of public health and quality of the environment. The computer code is expected to be used to support primarily the following activities: (a) to obtain heat transfer and flow data for the design of sealed storage casks for transport to, and storage at the proposed MRS facility; (b) to obtain heat transfer and flow data for storage of spent fuel assemblies in pools or transportable metal casks at reactor sites. It is therefore proposed that the research work be continued to modify and add to the BODYFIT-1FE code physical models and applicable equations that will simulate realistic configurations of shipping/storage casks.

34646 (DOE/RW—0147) Annotated outline for the SCP conceptual design report: Office of Geologic Repositories. (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). Jun 1987. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011599.

The Nuclear Waste Policy Act of 1982 (NWPA) requires that site characterization plans (SCPs) be submitted to the Nuclear Regulatory Commission (NRC), affected States and Indian tribes, and the general public for review and comment prior to the sinking of shafts at a candidate repository site. The SCP is also required by the NRC licensing procedures for the disposal of high-level waste. An Annotated Outline (AO) for Site Characterization Plans (OGR/B-5) has been prepared to provide DOE's standard format and guidance for preparation of SCPs. Consistent with the AO for SCPs. Chapter 6 of the SCP is to provide the requirements and references the media-specific design data base, describe the current design concepts, and discuss design information needs. In order to develop this design information, the Office of Geologic Repositories program is planning a SCP conceptual design phase as part of the overall repository design process. This phase is the first step in the design process, and the result and design can be expected to change as the program moves through the site characterization phase. The Annotated Outline which follows provides the standard format and guidance for the preparation of the SCP Conceptual Design Reports. It is considered to meet the intent of NRC's proposed Generic Technical Position philosophy contained therein. The SCP Conceptual Design Report will be the primary basis for preparation of Chapter 6 of the SCP and will be stand-alone reference document for the SCP. Appendix 1 to this Annotated Outline provides a correlation between Chapter 6 of the SCP and SCP Conceptual Design Report for the information purposes.

34647 (DP-MS—87-2) Nuclear waste glass corrosion mechanisms. Jantzen, C.M. (Savannah River Lab., Aiken, SC (USA)). Apr 1987. Contract AC09-76SR00001. 52p. (CONF-870422—4). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010182.

From 89. annual meeting of the American Ceramic Society; Pittsburgh, PA, USA (26 Apr 1987).

Dissolution of nuclear waste glass occurs by corrosion mechanisms similar to those of other solids, e.g., metallurgical and mineralogic systems. Metallurgical phenomena such as active corrosion, passivation and immunity have been observed to be a function of the glass composition and the solution pH. Hydration thermodynamics was used to quantify the role of glass composition and its effect on the solution pH during dissolution. A wide compositional range of natural, lunar, medieval, and nuclear waste glasses, as well as some glass-ceramics were investigated. The factors observed to affect dissolution in deionized water are pertinent to the dissolution of glass in natural environments such as the groundwaters anticipated to interact with nuclear waste glass in a geologic repository. The effects of imposed pH and oxidation potential (Eh) conditions existing in natural environments on glass dissolution is described in the context of Pourbaix diagrams, pH potential diagrams, for glass.

34648 (EGG-M—28586) Performance testing of high specific activity waste forms per 10 CFR Part 61. Neilson, R.M. Jr.; McConnell, J.W. Jr.; Rogers, R.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1987. Contract AC07-76ID01570. 10p. (CONF-870306—50). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009403.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The Low-Level Waste Data Base Development - EPICOR-II Resin/Liner Investigation Program of the US Nuclear Regulatory Commission (NRC) is obtaining information on radioactive waste by means of NRC-prescribed tests in a disposal environment. This paper describes the resin solidification task of that program

and includes the current test status and results. 28 refs., 5 figs., 6 tabs.

34649 **(EGG-M—29286) The incineration of absorbed liquid wastes in the INEL's [Idaho National Engineering Laboratory] WERF [Waste Experimental Reduction Facility] incinerator.** Steverson, E.M.; McFee, J.N. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 9p. (CONF-870306—51). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009412.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The concept of burning absorbed flammable liquids in boxes in the WERF incinerator was evaluated as a waste treatment method. The safety and feasibility of this procedure were evaluated in a series of tests. In the testing, the effect on incinerator operations of burning various quantities of absorbed flammable liquids was measured and compared to normal operations conducted on low-level radioactive waste (LLW). The test results indicated that the proposed procedure is safe and practical for use on a wide variety of solvents with quantities as high as one liter per box. No adverse or unacceptable operating conditions resulted from burning any of the solvents tested. Incineration of the solvents in this fashion was no different than burning LLW during normal incineration. 6 refs., 7 figs., 3 tabs.

34650 **(FMPC—2060) Feed Materials Production Center Waste Management: Annual report for fiscal year 1986.** Watts, R.E.; Kottner, S.A. (Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center). 1986. Contract AC05-86OR21600. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010585.

During FY-1986, the Westinghouse Materials Company of Ohio (WMCO) and the Department of Energy focused on safe storage and disposition of all wastes at the Feed Materials Production Center (FMPC) in compliance with federal and state regulations concerning waste management and worker health and safety. The Waste Management Annual Report identifies the comprehensive programs developed to achieve WMCO goals at the FMPC. The programs address waste issues which concern worker and public health and safety. Among those programs discussed are the decontamination, safe storage, and disposition of low-level and mixed hazardous radioactive waste. Principal attention and resources were allocated to programs which identify the largest waste streams (both currently generated and inventory backlogged). The most voluminous waste streams include low-level waste approved for shipment to the Nevada Test Site (MgF_2 slag, slag leach filter cake, and neutralized raffinate); remedial action wastes (K-65, stormwater runoff/effluent, and waste pits); thorium; and contaminated construction rubble and soil. Goals were established and met for the Waste Management Section in the form of completed milestones. The completed milestones involved such activities as characterization studies for the waste pits, K-65 Silos and adjacent areas; issuance of the Waste Management Plan required by DOE; analysis of decontamination alternatives for copper scrap; and analysis of silo structural integrity and remedial action alternatives.

34651 **(HEDL-SA—3609-VT) Fluidized bed calciner.** Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 8 Oct 1986. Contract AC06-76FF02170. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010218.

A unique way to convert radioactive scrap into useful nuclear fuel products was developed for the Department of Energy at Hanford. An advanced, fluidized bed calciner is used to convert metallic nitrate scrap or waste solutions into benign, solid and gaseous products. There are broad potential applications of this concept beyond those in the nuclear industry.

34652 **(K/SUB—85-22224/1) Hydrogeology of the Oak Ridge Gaseous Diffusion Plant site.** Kuhlmeier, P.D.; Sinclair, W.C.; Haymore, J.L. (Geraghty and Miller, Inc., Oak Ridge, TN (USA); Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jul 1986. Contract AC05-84OT21400. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010224.

This report discusses the methods used and data collected for the interpretation of the hydrogeology of the Oak Ridge Gaseous Diffusion Plant area. The report is based on a program of geologic study, test drilling, aquifer testing, and collection and interpretation of other hydrologic data. Ground water in the area is derived from local precipitation that infiltrates the uppermost aquifer and, in some areas moves into underlying bedrock aquifers. Ground water flows from areas of recharge, downgradient, along relatively short and shallow flow paths toward areas of discharge. Discharge from both the surficial and bedrock aquifers is to the banks and bottoms of the Clinch River and Poplar Creek. Rate of ground-water flow in the surficial aquifer is very slow, on the order of 10^{-4} ft/day, due to the low permeability of the unconsolidated aquifer material and the low gradients in the area. Movement of ground water through fractures and solution conduits in some of the carbonate bedrock aquifers is quite rapid, even where gradients are not particularly steep.

34653 **(LA—10927-MS) Minerals in fractures of the saturated zone from drill core USW G-4, Yucca Mountain, Nye County, Nevada.** Carlos, B.A. (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010830.

The minerals in fractures in drill core USW G-4, from the static water level (SWL) at 1770 ft to the base of the hole at 3000 ft, were studied to determine their identity and depositional sequence and to compare them with those found above the SWL in the same drill hole. There is no change in mineralogy or mineral morphology across the SWL. The significant change in mineralogy and relationship to the host rock occurs at 1381 ft, well above the present water table. Below 1381 ft clinoptilolite appears in the fractures and rock matrix instead of heulandite, and the fracture mineralogy correlates with the host rock mineralogy. Throughout most of the saturated zone (below the SWL) in USW G-4, zeolites occur in fractures only in zeolitic tuff; however, zeolites persist in fracture below the base of the deepest zeolitic tuff interval. Nonzeolitic intervals of tuff have fewer fractures, and many of these have no coatings; a few have quartz and feldspar coatings. One interval in zeolitic tuff (2125-2140 ft) contains abundant crisobalite coatings in the fractures. Calcite occurs in fractures from 2575 to 2660 ft, usually with the manganese mineral hollandite, and from 2750 to 2765 ft, usually alone. Manganese minerals occur in several intervals. The spatial correlation of zeolites in fractures with zeolitic host rock suggests that both may have been zeolitized at the same time, possibly by water moving laterally through more permeable zones in the tuff. The continuation of zeolites in fractures below the lowest zeolitic interval in this hole suggests that vertical fracture flow may have been important in the deposition of these coatings. Core from deeper intervals in another hole will be examined to determine if that relationship continues. 17 refs., 19 figs.

34654 **(LA-UR—87-1506) Field evaluation of a tensiometer data acquisition system for hydrologic studies of waste disposal site design.** Nyhan, J.W.; Drennon, B.J.; Gaylor, R.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870758—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010102.

From International conference on measurement of soil and plant water status; Logan, UT, USA (6 Jul 1987).

Commercially available differential pressure transducers, tensiometers and a data acquisition system were combined to study soil water tension changes with time within two trench cap designs used for the shallow land burial of waste materials. Apparent diurnal variations in soil water tension measured with this system are evaluated relative to field variations in temperature, atmospheric pressure and soil water content. Ongoing research is described which should improve the reliability of future soil water tension data collected in the field. 10 refs., 5 figs.

34655 **(LBL—23158) Determination of plutonium oxidation states at trace levels pertinent to nuclear waste disposal.** Nitsche, H.; Lee, S.C.; Gatti, R.C. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 27p. (CONF-870430—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010287.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

A scheme was developed for the determination of oxidation states of plutonium in environmental samples. The method involves a combination of solvent extractions and coprecipitation. It was tested on solutions with both high-level and trace-level concentrations. The scheme was used to determine Pu oxidation states in solutions from solubility experiments in groundwater from a potential nuclear waste disposal site. At steady-state conditions, Pu was found to be soluble predominantly as Pu(V) and Pu(VI).

34656 **(NP—7900728) Hazardous and radioactive mixed waste management plan: Final.** (Battelle Columbus Div., OH (USA)). 23 May 1986. 168p. NTIS MF A01. File Number DE87900728.

The Department of Energy (DOE) Order 5480.2 establishes hazardous waste management procedures for Atomic Energy Act (AEA) facilities such as the RMI Company Extrusion Plant (RMIEP). The procedures follow, to the extent practicable, regulations issued pursuant to RCRA. Therefore, an implementation plan for hazardous and radioactive mixed waste management has been developed to demonstrate that RMIEP will be brought into compliance with 40 CFR 264 at the earliest possible date. This hazardous radioactive mixed waste management plan has been developed in response to DOE Order 5480.2 and it contains the compliance information given in the Order. The plan follows in general the discussion presented in the DOE Guidance for preparing an implementation plan for DOE 5480.2.

34657 **(NUREG/CR—4651) Development of riprap design criteria by riprap testing in flumes: Phase 1.** Lee, D.W.; Abt, S.R.; Hinkle, N.E.; Khattak, M.S.; Nelson, J.D.; Ruff, J.F.; Shaikh, A.; Wittler, R.J. (Oak Ridge National Lab., TN (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Waste Management; Nuclear Regulatory Commission, Denver, CO (USA). Uranium Recovery Field Office; Colorado State Univ., Fort Collins (USA)). May 1987. Contract AC05-84OR21400. 116p. (ORNL/TM—10100). NTIS, PC A06/MF A01 - GPO. File Number TI87002199.

Flume studies were conducted in which riprap embankments were subjected to overtopping flows. Embankment slopes of 1, 2, 8, 10 and 20% were protected with riprap layers with median stone sizes of 1, 2, 4, 5 and/or 6 inches. Riprap design criteria for overtopping flows were developed in terms of unit discharge at failure, interstitial velocities and discharges through the riprap layer, resistance to flow over the riprap surface, potential impacts of the filter blanket on the riprap layer stability, and the effects of flow concentrations on the riprap stability. The resulting riprap design criteria were compared to the Stephenson, the US Army Corps of Engineers, the US Bureau of Reclamation, and the Safety Factors methods for riprap stone design; the Leps relation for interstitial velocities through riprap; and the Anderson et al. and Corps of Engineers relationships for estimating Manning's n values for resistance to flow. 16 refs., 24 figs., 18 tabs.

34658 **(ORNL/TM—9227) Heat transfer analyses for grout disposal of radioactive double-shell slurry and customer wastes.** Robinson, S.M.; Gilliam, T.M.; McDaniel, E.W. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 46p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87009782.

Grout immobilization is being considered by Rockwell Hanford Operations (Rockwell Hanford) as a permanent disposal method for several radioactive waste streams. These include disposal of customer and double-shell slurry wastes in earthen trenches and in single-shell underground waste storage tanks. Heat transfer studies have previously been made to determine the maximum heat loading for grout disposal of various wastes under similar conditions, but a sensitivity analysis of temperature profiles to input parameters was needed. This document presents the results of heat transfer calculations for trenches containing grouted customer and double-shell slurry wastes and for in situ disposal of double-shell wastes in single-shell, domed concrete storage tanks. It discusses the conditions that lead to maximum grout temperatures of 250°F during the curing stage and 350°F thereafter and shows the dependence of these temperatures on input parameters such as soil and grout thermal conductivity, grout specific heat, waste loading, and disposal geometries. Transient heat transfer calculations were made using the HEATING6 computer code to predict temperature profiles in solidified low-level radioactive waste disposal scenarios at the Rockwell Hanford site. The calculations provide guidance for the development of safe, environmentally acceptable grout formulas for the Transportable Grout Facility. 11 refs.

34659 **(PB—87-167136/XAB) Sampling the oceans for pollution: a risk-assessment approach to evaluating low-level radioactive waste disposal at sea.** Prager, J.C.; Bierman, V.J.; Paul, J.F.; Bonner, J.S. (Environmental Protection Agency, Narragansett, RI (USA). Environmental Research Lab.). 1986. 27p. (EPA—600/J-86/249). NTIS, PC A03/MF A01.

Pub. in Dangerous Properties of Industrial Materials Report, Vol. 6, No. 3, 2-26(May/Jun 1986).

A protocol for licensing disposal of low-level radioactive wastes in the deep ocean is proposed. It is based on principles of risk assessment. Assessments of waste characteristics and site characteristics are integrated to predict an exposure field within which concentrations of the waste at any point are calculated. From these concentrations, and an assessment of pollutant effects on indigenous species, the likelihood of environmental harm may be evaluated so that risks can be managed by regulatory agencies. Current progress toward implementing this protocol is described.

34660 **(PNL—5981) FACSIM/MRS [Monitored Retrievable Storage]-2: Storage and shipping performance assessment.** Hostick, C.J.; Otis, P.T.; Chockie, A.D.; Sovers, R.A; Huber, H.D. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011233.

This report provides a performance assessment of the designs for the storage and shipping operations of the MRS facility. These activities, referred to as back-end operations, including handling canistered spent fuel and secondary waste in the shielded canyon cell, in onsite yard storage, and in repository shipping cask loading areas. This analysis verified that the MRS facility back-end operations as designed are capable of handling 3600 metric tons of uranium (MTU) per year if the facility operates seven days per week (24-hour days). The cask cart utilization rate is highest, in use about 50% of the operating year. Cask cart utilization refers to the utilization of the shielded canyon cell repository shipping cask loadout port (also referred to as the exit port) and the cask cart that serves that port. The receiving and handling facility design specifies two loadout ports, one for each side of the facility. This analysis also determined that a throughput rate of 3000 MTU per year could be achieved with five-day week facility operation.

34661 **(PNL—6003) FACSIM/MRS [Monitored Retrievable Storage]-2: Storage and shipping model documentation and user's guide.** Huber, H.D.; Chockie, A.D.; Hostick, C.J.; Otis, P.T.; Sovers, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87011699.

The Pacific Northwest Laboratory (PNL) has developed a stochastic computer model, FACSIM/MRS, to assist in assessing the operational performance of the Monitored Retrievable Storage (MRS) waste-handling facility. This report provides the documentation and user's guide for FACSIM/MRS-2, which is also referred to as the back-end model. The FACSIM/MRS-2 model simulates the MRS storage and shipping operations, which include handling canistered spent fuel and secondary waste in the shielded canyon cells, in onsite yard storage, and in repository shipping cask loading areas.

34662 **(PNL—6004) FACSIM/MRS-1: Cask receiving and consolidation model documentation and user's guide.** Lotz, T.L.; Shay, M.R. (Pacific Northwest Lab., Richland, WA (USA)). Jun 1987. Contract AC06-76RL01830. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011106.

The Pacific Northwest Laboratory (PNL) has developed a stochastic computer model, FACSIM/MRS, to assist in assessing the operational performance of the Monitored Retrievable Storage (MRS) waste-handling facility. This report provides the documentation and user's guide for the component FACSIM/MRS-1, which is also referred to as the front-end model. The FACSIM/MRS-1 model simulates the MRS cask-receiving and spent-fuel consolidation activities. The results of the assessment of the operational performance of these activities are contained in a second report, FACSIM/MRS-1: Cask Receiving and Consolidation Performance Assessment (Lotz and Shay 1987). The model of MRS canister storage and shipping operations is presented in FACSIM/MRS-2: Storage and Shipping Model Documentation and User's Guide (Huber et al. 1987). The FACSIM/MRS model uses the commercially available FORTRAN-based SIMAN (SIMulation ANalysis language) simulation package (Pegden 1982). SIMAN provides a set of FORTRAN-coded commands, called block operations, which are used to build detailed models of continuous or discrete events that make up the operations of any process, such as the operation of an MRS facility. The FACSIM models were designed to run on either an IBM-PC or a VAX minicomputer. The FACSIM/MRS-1 model is flexible enough to collect statistics concerning almost any aspect of the cask receiving and consolidation operations of an MRS facility. The MRS model presently collects statistics on 51 quantities of interest during the simulation. SIMAN reports the statistics with two forms of output: a SIMAN simulation summary and an optional set of SIMAN output files containing data for use by more detailed post processors and report generators.

34663 **(PNL—6035) Parameters influencing the aerosol capture performance of the Submerged-Bed Scrubber.** Ruecker, C.M.; Scott, P.A. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009705.

The Submerged-Bed Scrubber (SBS) is a novel air cleaning device that has been investigated by Pacific Northwest Laboratory (PNL) for scrubbing off gases from liquid-fed ceramic melters used to vitrify high-level waste (HLW). The concept for the SBS was originally conceived at Hanford for emergency venting of a reactor containment building. The SBS was adapted for use as a quenching scrubber at PNL because it can cool the hot melter off gas as well as remove over 90% of the airborne particles, thus meeting the minimum particulate decontamination factor (DF) of 10 required of a primary scrubber. The experiments in this study showed that the submicron aerosol DF for the SBS can exceed 100 under certain conditions. A conventional device, the ejector-venturi scrubber (EVS), has been previously used in this application. The EVS also adequately cools the hot gases from the melter while exhibiting aerosol removal DFs in the range of 5 to 30. In addition to achieving higher DFs than the EVS, however, the SBS has the advantage of being a passive system, better suited to the remote environment of an HLW processing system. The objective of this study was to characterize the performance of the SBS and to improve the aerosol capture efficiency by modifying the operating procedure or the design. A partial factorial experimental matrix was completed to determine the main effects of aerosol solubility, inlet off-gas temperature, inlet off-gas flow rate, steam-to-air ratio, bed diameter and packing diameter on the particulate removal efficiency of the SBS. Several additional experiments were conducted to measure the influence of the inlet aerosol concentration and scrubbing-water concentration on aerosol-removal performance. 33 refs., 17 figs., 14 tabs.

34664 **(PNL—6083) Development of an in situ method to define the rheological properties of slurries and sludges stored in underground tanks.** Heath, W.O. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87009462.

A method for measuring the in situ flow properties of high-level radioactive waste (HLW) sludges has been developed at Pacific Northwest Laboratory, along with a preconceptual design for a shear vane device that can be installed in underground HLW storage tanks and used to make those measurements remotely. The data obtained with this device will assist in the design of mixing equipment used to resuspend and remove HLW sludges from their storage tanks for downstream processing. This method is also suitable for remotely characterizing other types of waste sludges and slurries. Commonly available viscometric methods were adapted to allow characterization of sludge samples in the laboratory such that the laboratory and in-tank data can be directly compared (scaled up). Procedures for conducting measurements and analyzing the results in terms of useful mathematical models describing both start-up and steady-state flow behavior are presented, as is a brief tutorial on the types of flow behavior that can be exhibited by tank sludges. 30 refs., 36 figs., 14 tabs.

34665 **(PNL—6170) Cesium chloride compatibility testing program: Annual report for fiscal year 1986.** Bryan, G.H. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011232.

A program was started to evaluate the compatibility of Waste Encapsulation and Storage Facility (WESF)-produced cesium chloride (CsCl) with 316L stainless steel (SS) under thermal conditions that may be encountered in a geologic repository. Objective is compatibility testing of six standard WESF capsules at a max metal/CsCl interface temperature of ~450°C. Test capsule No. C-1351 was removed from its insulated container after being held at temperature for 28,268 h (3.2 y). The average max interface temperature for the 3.2-y capsule was 445°C. Metal corrosion in the 3.2-y capsule was extensive throughout the capsule, except in the upper portion of the capsule where the interface temperature was below 400°C. The maximum corrosion found was 460 μm (0.018 in.). Overall corrosion in the hotter portion of the 3.2-y capsule increased linearly with time. Intergranular attack was much more apparent in the tests of longer duration, while pitting and a general surface attack appeared to predominate in the shorter tests. In the area where the temperature was below 400°C, the attack was greatly reduced. Results indicate that in the hotter portion of the capsule (where the metal/CsCl interface temperature is above 400°C the corrosion is proceeding at a linear rate. If metal corrosion at the higher temperatures proceeds at a linear rate for an extended period of time, it has serious implications for the geologic disposal of the WESF CsCl capsules. Estimates of long-term metal attack in a geological repository are discussed.

34666 **(PNL/SRP—6225) Salt Repository Project: Data report on corrosion results obtained from excess-salt corrosion test Matrix 1.** Haberman, J.H.; Westerman, R.E. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 12p. NTIS, PC A02/MF A01; 2; GPO Dep. File Number DE87010615.

The test discussed in this data report was directed at determining the response of the reference A216 grade WCA steel when it is exposed to anoxic excess-salt conditions at 150°C. The environment used in the test was intended to duplicate the intrusion brine scenario (i.e., the formation of brine by the intrusion of water from an outside source into the repository, with the formation of brine through dissolution of salt from the repository horizon). The salt-brine environment used in the test therefore reflected the expected gross salt composition of the repository horizon.

34667 **(RHO-PB-SR—10) Defense Waste and Transportation Management monthly report.** (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1986. Contract AC06-77RL01030. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87008295.

A month's worth of work is summarized for the following programs: defense waste and transportation management program; interim waste management program; lead site programs and other studies (which include defense high-level waste technology, Hanford waste vitrification plant, decontamination and decommissioning of surplus facilities, and transuranic waste technology); and facilities upgrade/landlord program.

34668 (RHO-RE-EV—82-P) Near-field evaluation of subsidence and geotechnical remedial actions at hazardous and radioactive materials disposal sites. Phillips, S.J.; Gilbert, T.W. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Mar 1985. Contract AC06-77RL01030. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009304.

Geomechanical subsidence and differential settlement are a concern of radioactive- and hazardous-waste disposal site operators. Subsidence at these sites may result in periodic maintenance requirements, and in specific instances, dispersal of the contaminants from their original zone of confinement. Amelioration of geomechanical subsidence within the working environment of disposal site requires development, modification, demonstration, and quantitative evaluation of select geotechnical engineering technologies. To this end, dynamic consolidation/compaction alternatives (accelerating mass ground surface impact, vibratory rod or cylinder injection/withdrawal, and diesel hammer rod or cylinder injection) were tested under field conditions using simulated waste forms disposed from 1.0 to 5.0 m below grade in axisymmetric backfilled depressions. Monitoring and technical assessment of the alternatives' performance demonstrated matrix geologic media and waste package orthogonal acceleration and displacement maxima of 1.0 g and 6.0 x $10\mu^{-4}$ m, respectively, at distances of only a few meters from accelerated mass impact or rod/cylinder injection points. Net physical displacement was significant within approximately 1.5 m. The tested dynamic consolidation alternatives were effective in prompting substantial geomechanical subsidence under controlled conditions as evidenced by structural failure of simulated waste forms and by waste-form compaction below grade as determined by visual inspection. 11 refs., 7 figs.

34669 (RHO-RE-SA—170P) Stabilization and isolation of low-level waste disposal sites. Phillips, S.J.; Gilbert, T.W. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1987. Contract AC06-77RL01030. 22p. (CONF-870306—52). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008698.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Rockwell Hanford Operations is developing and testing equipment for stabilization and isolation of low-level radioactive liquid waste disposal sites. Stabilization and isolation are accomplished by a dynamic consolidation and particulate grout injection system. System equipment components include: a mobile grout plant for transport, mixing, and pumping of particulate grout; a vibratory hammer/extractor for consolidation of waste and backfill and for emplacement of the injector; a dynamic consolidation/injector probe for introducing grout into fill material; and an open-void surface injector that uses surface or subsurface mechanical or pneumatic packers and displacement gas filtration for introducing grout into disposal structure access piping. Treatment of a liquid-waste disposal site yields a physically stable, cementitious monolith. Additional testing and modification of this equipment for other applications to liquid waste disposal sites is in progress. 10 refs., 5 figs.

34670 (RHO-RE-SA—177-P) Waste Characterization Program Development for Hanford Grout Disposal. Richmond, W.G. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Apr 1987. Contract AC06-77RL01030. 20p. (CONF-870306—54). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010666.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Disposal of the low-level fraction of liquid double-shell tank waste in a cementitious grout matrix requires detailed characterization of the candidate waste streams to allow development of grout formulations and to support the preparation of environmental documentation. The Hanford Grout Disposal Program plan for meeting these requirements is described. This discussion includes the methodology for plan development, the identification of waste species requiring analysis and the corresponding lower limits of detection, and the bases for determining these limits. The use of predictor analysis for determining information required for evaluating the environmental impact of the disposal action is also discussed. 9 refs., 7 tabs.

34671 (SAND—83-0070) NNWSI unit evaluation at Yucca Mountain, Nevada Test Site: Near field mechanical calculations using a continuum jointed rock moel in the JAC code. Thomas, R.K. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011577.

The Nevada Nuclear Waste Storage Investigations (NNWSI) Project, managed by the Nevada Operations Office of the US Department of Energy, is examining the feasibility of siting a repository for high level nuclear wastes at Yucca Mountain on and adjacent to the Nevada Test Site (NTS). The work reported herein was done to support the selection, on a technical basis, of a single target repository horizon upon which to concentrate future activities. Presented in this report are the results of a comparative study between two candidate horizons: the devitrified Topopah Spring member of the Paintbrush Tuff and the nonwelded, zeolitized Tuffaceous Beds of Calico Hills. Performance of a repository sited in each candidate horizon was assessed by conducting structural calculations using a two-dimensional room-and-pillar geometry and average and limit material properties. The computer code JAC, with a constitutive model for jointed rock masses, was used to make the calculations. Based on analyses of the confining pressures in the pillar and the joint movement near the room, it is concluded that the Topopah Spring unit is more suitable than the Calico Hills unit for the placement of a nuclear waste repository. Finally, a comparison is made with a similar mine geometry sited in the Grouse Canyon Tuff, a horizon of known performance characteristics, using properties from G-Tunnel at NTS.

34672 (SAND—85-7115) Numerical analyses of the G-Tunnel small-diameter heater experiments. Blanford, M.L.; Osnes, J.D. (RE/SPEC, Inc., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 149p. NTIS, PC A07. File Number DE87011575.

Late in the spring of 1982, Sandia National Laboratories began a series of three Small-Diameter Heater experiments under the Nevada Nuclear Waste Storage Investigations project. These experiments were fielded in two phases on the Nevada Test site in G-Tunnel. Phase I consisted of a constant-power heater placed in a vertical borehole - first in welded tuff, then in nonwelded. Phase II involved emplacement of the heater in a horizontal borehole in welded tuff, with the heater power incremented in four discrete steps. This report summarizes finite element heat transfer analyses of the two phases of the experiments. The analyses were at first used to assist in experiment design, and later to model the time-dependent response of the system to the applied thermal loads. The analysis results compare favorably with experimentally measured temperatures.

34673 (SAND—86-2201) Verification of ground motion data processing codes. Phillips, J.S. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010527.

This report documents the exercise done to verify that the computer codes used to process ground motion data from underground nuclear explosions are producing correct results. The routines of interest are those that produce the power spectrum (program SPEC) and perform the filtering and integration (program SAM). Analytical functions with known characteristics were input into the codes and the results generated were checked against the input. The conclusion was reached that SAM and SPEC provide correct results.

34674 (SAND—86-2226) The subseabed disposal project institutional program activities: October 1984 through September 1985. Bertram, S.G. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87009237.

This report covers the FY85 institutional activities of the Subseabed Disposal Project. An introduction and a general descrip-

tion of each activity is included. Detailed descriptions are contained in the appendices. 3 refs.

34675 **(SAND—86-2526) 1984 subseabed disposal project annual report: Physical oceanography and water column geochemistry studies: October 1983 through September 1984.** Kupferman, S.I. (ed.). (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87008891.

This report covers the work of the Physical Oceanography and Water Column Geochemistry (POWCG) group of the Subseabed Disposal Project (SDP) from October 1983 through September 1984. A summary of the work is given which includes an introduction to and general descriptions of the groups' activities. Detailed discussions are included as appendices. During the period of this report, the POWCG group was instrumental in the designation of the Nares Abyssal Plain as a study area for the SDP Environmental Studies Group and planned and staged the first interdisciplinary SDP oceanographic mission to the Nares.

34676 **(SAND—86-2803) Summary report on the Endeavor 137 Legs 1 and 2 expedition: The Nares Abyssal Plain, November 9-27, 1985.** Shephard, L.E.; Laine, E.P. (eds.). (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 44p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87010991.

A research expedition to the Nares Abyssal Plain was conducted on board the R/V Endeavor between November 9-27, 1985. The primary objectives of the expedition were to recover and deploy current meter moorings Nares II and III, respectively, and to obtain the necessary physical, chemical, and biological data for input to an environmental model being developed for this area. Severe weather conditions related to Hurricane Kate during Leg I limited the amount of data obtained. Each of the primary objectives was achieved, however, and enough data were collected to provide a cursory evaluation of the environmental characteristics of the Nares Abyssal Plain.

34677 **(SAND—86-7005) Reference thermal and thermal/mechanical analyses of drifts for vertical and horizontal emplacement of nuclear waste in a repository in tuff.** St. John, C.M. (Agapito (J.F.T.) and Associates, Inc., Rolling Hills Estates, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010989.

Two-dimensional thermal and thermal/mechanical analyses of the designs of drifts for vertical and horizontal emplacement of nuclear waste in a repository in tuff were performed using boundary-element and finite-element computer codes. The fine-element analyses considered the two extreme alternatives of continuous ventilation for 100 yr after waste emplacement and that of no ventilation at any time. The boundary-element code was utilized during scoping studies and it also provided independent verification of the results of the finite-element analyses. The analyses predict the development of increased horizontal stress levels in the rock mass as a result of waste emplacement. These are moderated significantly by ventilation in the case of vertical emplacement, because the drifts are spaced sufficiently close for a substantial amount of the heat generated by the waste to be removed by the ventilating air. Even without such a moderating influence, there is no evidence that the stresses induced by waste emplacement would lead to drift instability. For none of the cases considered was there any indication of a potential for failure of the rock matrix. Regions of overstress of joints were predicted in all cases, but such regions were small and are judged to be of little or no practical significance to the stability of the emplacement drift. 33 refs., 37 figs., 11 tabs.

34678 **(SAND—86-7011) Investigation of excavation stability in a finite repository.** St. John, C.M.; Mitchell, S.J. (Agapito (J.F.T.) and Associates, Inc., Rolling Hills Estates, CA (USA); Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010993.

Two-dimensional thermal-mechanical analyses of a hypothetical repository in tuff were performed using a boundary-element computer code, with the objective of investigating the relative stability of several waste emplacement panel access drifts. The drifts were assumed to be located within a central shaft pillar, within a small pillar between adjacent panels, or at the repository perimeter. The results of analyses indicate that matrix failure is unlikely and that the extent of activation of pre-existing joints is influenced by the drift location and the initial state of stress. The results also show that several years after waste emplacement the influence of the initial State of Stress is small compared to the influence of thermally induced stresses. Regions of joint activation are seen to be most extensive around the drifts between adjacent panels. The predicted extent of such activation was small when it was assumed that the joints were vertical or near vertical. More extensive regions of activation of shallow dipping joints were noted. However, joints of such orientation are believed to occur relatively infrequently in the candidate horizon for waste emplacement and the activation of the shallow dipping joints does not necessarily lead to drift stability concerns. 3 refs., 24 figs., 7 tabs.

34679 **(UCRL—15905) Assessment of the proposed decontamination and waste treatment facility at LLNL.** Cohen, J.J. (Science Applications International Corp., Pleasanton, CA (USA); Lawrence Livermore National Lab., CA (USA)). 25 Mar 1987. Contract W-7405-ENG-48. 36p. (SAIC—87/1600). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009565.

To provide a centralized decontamination and waste treatment facility (DWTF) at LLNL, the construction of a new installation has been planned. Objectives for this new facility were to replace obsolete, structurally and environmentally sub-marginal liquid and solid waste process facilities and decontamination facility and to bring these facilities into compliance with existing federal, state and local regulations as well as DOE orders. In a previous study, SAIC conducted a preliminary review and evaluation of existing facilities at LLNL and cost effectiveness of the proposed DWTF. This document reports on a detailed review of specific aspects of the proposed DWTF.

34680 **Radioactive waste processing apparatus.** Nelson, R.E.; Ziegler, A.A.; Serino, D.F.; Basnar, P.J. (to Dept. of Energy, Washington, DC). US Patent 4,666,676. 19 May 1987. Filed date 30 Aug 1985. vp.

This patent describes an apparatus for use in processing liquid radioactive waste materials for storage in solid form in a container having a substantially cylindrical wall. The wall has a substantially vertical axis, a top secured to the wall, the top having a container opening which is smaller than the area defined by the circumference of the top at the wall. The container holds a predetermined amount of an uncured fixing agent. The apparatus comprises: an enclosure into which the container may be placed. The enclosure includes walls, a bottom and a cover, one of the walls including a door opening through which the container may be placed in the enclosure or removed from the enclosure. The enclosure includes a movable tray for supporting the container in the enclosure, and at least one lifting cylinder for raising and lowering the tray.

34681 **Immodest proposal for dealing with radioactive wastes.** Weinberg, A.M. (Institute for Energy Analysis, Oak Ridge Associated Universities, Oak Ridge, TN). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 1, 22-23(Oct 1986).

The problem of disposal of nuclear wastes is more political than technical. Essentially all high-level waste accident scenarios involve at worst exposure to levels of radiation that are so low as to be in the range where health effects, if they exist, are miniscule. However, states and localities are refusing to be considered as locations for monitored and retrievable, or permanent geological, repository facilities. Such opposition is not on the basis of safety, but rather on the implications which such a "waste dump" would have for the area. It is proposed that a fund be established, for example $100 million per year, to be paid to a state to compensate for any presumed disadvantages of accepting a nuclear waste storage or disposal facility.

34682 Electrochemical processing of alkaline nitrate and nitrite solutions. Hobbs, D.T.; Ebra, M.A. New York, NY; American Institute of Chemical Engineers (1986). 25p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC09-76SR00001.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Processing of high-level waste at the Savannah River Plant (SRP) will produce, as a by product, a low- level, alkaline salt solution containing approximately 17% sodium nitrate and sodium nitrite. This solution will be incorporated into a cement formulation, saltstone, and placed in an engineered landfill. Electrochemical methods have been investigated to decrease the nitrate and nitrite in this solution in order to lower the leaching of nitrate and nitrite from saltstone and to reduce the volume of saltstone. Laboratory experiments have demonstrated the technical feasibility of electrolytically reducing the nitrate and nitrite in a synthetic salt solution similar in composition to that expected to be produced at SRP. Greater than 99% of the sodium nitrate and sodium nitrite can be reduced, producing ammonia, nitrogen, oxygen, and sodium hydroxide. In addition, significant reductions in the volume of saltstone may be realized if the sodium hydroxide produced by electrolysis can be recycled.

34683 The application of electrorefining for recovery and purification of fuel discharged from the Integral Fast Reactor. Burris, L.; Steunenberg, R.K.; Miller, W.E. New York, NY; American Institute of Chemical Engineers (1986). 36p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract W-31-109-ENG-38.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

An electrorefining process employing a molten salt electrolyte and a molten cadmium anode is proposed for the separation of uranium and plutonium from fission products and cladding material in discharged IFR driver fuel. The use of a liquid cadmium anode, which is the unique feature of the process, permits selective dissolution of the fuel from the cladding and prevents electrolytic corrosion of the steel container and contamination of the product by noble metal fission products.

34684 Electrochemical process for dissolving plutonium dioxide and leaching plutonium from scrap or wastes. Bray, L.A.; Ryan, J.L.; Wheelwright, E.J. New York, NY; American Institute of Chemical Engineers (1986). 24p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC06-76RL01830.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Dissolution of plutonium (Pu) from high-fired plutonium dioxide (PuO/sub 2/) and the leaching of Pu from scrap or wastes have often posed difficult process problems. Traditionally, dissolution has been accomplished using 12 M HNO/sub 3/-0.18 M HF at boiling temperatures. This work discusses the development of electrochemical solution of PuO/sub 2/ in compartmented cells. Small amounts of oxidation catalysts are used to carry electrons from the solid PuO/sub 2/ to the anode surface, producing PuO/sub 2//sup 2+/ in solution. PuO/sub 2/ that has been fired at temperatures to 1700°C can be dissolved at 25°C to concentrations exceeding 400 g Pu/L using the catalyzed electrochemical plutonium oxide dissolution (CEPOD) process. The silver ion is used as the redox catalyst.

34685 Groundwater contamination by radioactive waste. Rahn, P.H. (South Dakota School of Mines and Technology, SD). pp 233-246 of Environmental geotechnology. Fang, H.Y. Bethlehem, PA; Envo Publishing Co., Inc. (1986). (CONF-860430—).

From International symposium on environmental geotechnology; Allentown, PA, USA (21 Apr 1986).

Ground water at numerous places in the United States has become contaminated by radioactive substances. Serious incidents of ground-water contamination have been caused by the injection or leakage of wastes at federal facilities (e.g. Idaho Falls, ID, and Richland, WA). There have also been incidents of contamination in connection with seepage from low-level radioactive waste sites. The metallurgical processing of uranium ore has produced millions of tons of tailings which, although low in radioactivity, have long half-lives and the potential for ground-water contamination. Radioactive ground-water contamination can be mitigated or completely avoided by proper disposal techniques.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 34658, 34685, 34688, 35695, 35704, 35740, 35741

34686 (NUREG—0332) Potential health and environmental impacts attributable to the nuclear and coal fuel cycles: Final report. Gotchy, R.L. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Jun 1987. 71p. NTIS, PC A04/MF A01 - GPO. File Number TI87900835.

Estimates of mortality and morbidity are presented based on present-day knowledge of health effects resulting from current component designs and operations of the nuclear and coal fuel cycles, and anticipated emission rates and occupational exposure for the various fuel cycle facilities expected to go into operation during the next decade. The author concluded that, although there are large uncertainties in the estimates of potential health effects, the coal fuel cycle alternative has a greater health impact on man than the uranium fuel fycle. However, the increased risk of health effects for either fuel cycle represents a very small incremental risk to the average individual in the public for the balance of this century. The potential for large impacts exists in both fuel cycles, but the potential impacts associated with a runaway Greenhouse Effect from combustion of fossil fuels, such as coal, cannot yet be reasonably quantified. Some of the potential environmental impacts of the coal fuel cycle cannot currently be realistically estimated, but those that can appear greater than those from the nuclear fuel cycle. 103 refs., 1 fig., 18 tabs.

34687 Environmental geotechnology and public concerns due to uranium mine and mill tailings. Parate, N.S. (Oak Ridge National Lab., TN). pp 247-256 of Environmental geotechnology. Fang, H.Y. Bethlehem, PA; Envo Publishing Co., Inc. (1986). (CONF-860430—).

From International symposium on environmental geotechnology; Allentown, PA, USA (21 Apr 1986).

The increased use of nuclear technology for power, weapons, medicinal isotopes production along with research and development activities during the last five decades has resulted in the increased use and activities of uranium mining, milling, processing and thereby resulted in large contaminated tailings and mine site areas as a potential danger to the health and human environment. This has caused environmental geotechnical and public concerns. During the recent years efforts are in progress to study, evaluate and design the remedial actions and measures to protect the public both present and future for up to 200 to 1000 years as per UMPTRA act and EPA 83, 10 CFR 192 control standards incorporating the DOE and NRC responsibilities.

0540 Health And Safety

REFER ALSO TO CITATION(S) 34615, 34686, 34869, 35826, 35844

34688 (DOE/EIS—0132-D-Vol.2) Remedial actions at the former Union Carbide Corporation uranium mill sites, Rifle, Garfield County, Colorado: Volume 2, Appendices: Draft Environmental Impact Statement. (USDOE Albuquerque Operations Office, NM. Uranium Mill Tailings Remedial Action Project Office). May 1987. 591p. NTIS, PC A25/MF A01; 1; GPO Dep. File Number DE87010644.

This volume contains eleven appendices to the draft Environmental Impact Statement. The appendices describe the following subjects: conceptual designs; alternatives analysis; weather, air quality, and noise; soils, geology, and seismicity; hydrology; floodplain and wetlands assessment; biology; radiation; cultural and his-

toric resources; land use and socioeconomics; and permits, licenses, and approvals. (PLG)

34689 **(K/TS—11-872) Preliminary safety analysis report: Centrifuge Plant Demonstration Facility, Building K-1220.** (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jun 1987. Contract AC05-84OT21400. 501p. NTIS, PC A22/MF A01; 1; GPO Dep. File Number DE87010583.

The factors and precautions necessary to protect the safety of operating personnel at the CPDF, safety of the public, and safety of the facility itself are summarized. This summary includes a discussion of the results of the site analysis, the impact of normal and abnormal operations, credible accident situations, and conclusions relative to the safety-related impact of the plant. This analysis covers activities at K-1220 only and does not touch on other process-related operations in support of CPDF such as waste treatment in K-1200 (CPL); waste burial at the ORGDP contaminated, classified burial ground; and oil disposal at Y-12.

34690 **(NUREG/CR—4938) Occupational radiation exposures associated with alternative methods of low-level waste disposal.** Herrington, W.N.; Harty, R.; Merwin, S.E. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). May 1987. Contract AC06-76RL01830. 87p. (PNL—6217). NTIS, PC A05/MF A01. File Number TI87010733.

The Low-Level Radioactive Waste Policy Amendments (LLRWPA) Act of 1985 assigns the responsibility for disposal of low-level radioactive wastes to individual states. The Act also mandates that the US Nuclear Regulatory Commission (NRC), in consultation with states and other interested parties, identify disposal methods other than shallow land burial (SLB), the method currently used at the three low-level waste (LLW) disposal sites operating in the United States. The NRC contracted with Pacific Northwest Laboratory (PNL) to compare projected occupational exposures associated with the SLB method and five alternative disposal methods, including below ground vaults (BGV), above ground vaults (AGV), earth mounded concrete bunkers (EMCB), augured holes (AH) and minded cavities (MC). This report is intended to inform state and local governments about these projected exposures in anticipation of their participation in siting new low-level waste disposal facilities. The results of this study suggest that, with the design and operation assumptions made in this study, occupational dose equivalents for the five methods examined in detail would be highest for the EMCB method (1.81 person-mrem/m^3 of waste disposed). The lowest occupational dose equivalents would occur for the AH method (1.29 person-mrem/m^3). Projected occupational dose equivalents for SLB, BGV, and AGV disposal methods are 1.38, 1.47, and 1.61 person-mrem/m^3, respectively. Based on simularities between the reference BGV and MC facilities, it was projected that the occupational dose equivalents for a MC facility would be 40% higher than for the reference BGV facility. 17 refs., 15 figs., 13 tabs.

34691 **Analysis of uranium solutions using Laser-induced Breakdown Spectroscopy.** Cremers, D.A.; Wachter, J.R. (Chemistry and Laser Sciences Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 28-31 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WC3.

The application of laser-induced breakdown spectroscopy (LIBS) to the measurement of the uranium content in solution is under investigation. This method utilizes a focused laser pulse to produce a hot spark that vaporizes the solution and generates a plasma of electrons and excited ions and neutral atoms. Spectral and temporal resolution of the plasma light permits identification of the atomic constituents. The LIBS technique has several potential advantages compared to conventional methods. No sample handling or preparation is needed because only optical access is required to produce and observe the plasma. The technique is fast because the laser spark simultaneously vaporizes and excites the sample. In addition, LIBS is unaffected by gamma-ray signals from high concentrations of fission products. This report presents the results of an investigation of the suitability of LIBS for analysis of uranium solutions. Topics discussed include dynamic range, precision, detection limit, and the effects of some experimental parameters on the analysis.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 34595, 34607, 34608, 34609, 34827, 35533

34692 **(IAEA-STR—244-Rev.0-Vol.2) Generalized procedures for determining inspection sample sizes (related to quantitative measurements). Vol. 2: Tables and concise procedures (working papers).** Jaech, J.L.; Lemaire, R.J. (International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards). Nov 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87702282.

Generalized procedures have been developed to determine sample sizes in connection with the planning of inspection activities. These procedures are based on different measurement methods. They are applied mainly to Bulk Handling Facilities and Physical Inventory Verifications. The present report attempts (I) to assign to appropriate statistical testers (viz. testers for gross, partial and small defects) the measurement methods to be used, and (II) to associate the measurement uncertainties with the sample sizes required for verification. Working papers are also provided to assist in the application of the procedures. This volume contains the tables and concise procedural working papers.

34693 **(LA—10961-MS) Prescriptive concepts for advanced nuclear materials control and accountability systems.** Whitty, W.J.; Strittmatter, R.B.; Ford, W.; Tisinger, R.M.; Meyer, T.H. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010832.

Networking- and distributed-processing hardware and software have the potential of greatly enhancing nuclear materials control and accountability (MC and A) systems, from both safeguards and process operations perspectives, while allowing timely integrated safeguards activities and enhanced computer security at reasonable cost. A hierarchical distributed system is proposed consisting of groups of terminal and instruments in plant production and support areas connected to microprocessors that are connected to either larger microprocessors or minicomputers. These micros and/or minis are connected to a main machine, which might be either a mainframe or a super minicomputer. Data acquisition, preliminary input data validation, and transaction processing occur at the lowest level. Transaction buffering, resource sharing, and selected data processing occur at the intermediate level. The host computer maintains overall control of the data base and provides routine safeguards and security reporting and special safeguards analyses. The research described outlines the distribution of MC and A system requirements in the hierarchical system and distributed processing applied to MC and A. Implications of integrated safeguards and computer security concepts for the distributed system design are discussed. 10 refs., 4 figs.

34694 **(LA—10967-MS) Holdup measurements of the Rocky Flats Plant 371 precipitator canyons.** Russo, P.A.; Sprinkle, J.K. Jr.; Elmont, T.H. (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009481.

A shielded NaI(Tl) gamma-ray detector with portable electronics and automated data reduction and readout was used to measure the plutonium holdup on the floors of the Rocky Flats Plant Building 371 precipitator canyons. The amount of plutonium on the floors was determined to be 373 +- 84 g. Based on estimates applied to the very high background count rates measured at specific locations in the precipitator canyons, as little as 300 g and as much as 2400 g of plutonium could be accumulated in a localized section of the precipitator canyon plumbing. The NaI(Tl) detection system was also used to evaluate certain aspects of the procedures applied to the treatment of concrete core samples removed from the floors of the precipitator canyons for purposes of verification of

the holdup measurements. This evaluation demonstrated that the treatment of the core samples before analysis for verification was effective in extracting more than 90% of the plutonium from the concrete cores. 1 ref., 6 figs., 7 tabs.

34695 **(LA—10969-MS) In-line shuffler error analysis.** Adams, E.L.; Crane, T.W.; Ensslin, N. (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009482.

This report is an error analysis of two in-line californium shufflers that provide nondestructive assays of highly enriched uranium. Calculated and measured errors are described and compared. 3 refs., 2 tabs.

34696 **(LA—10974-MS) Measurement control program for new special recovery.** Hsue, S.T.; Campbell, K.; Barlich, G. (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010833.

This report summarizes the design of the measurement control (MC) program for the New Special Recovery facility. The MC program is divided into two levels. Level 1 MC checks are performed at the individual instrument computer and will always be functional even when the instrument-control computer is down. The level 1 MCs are divided into statistical checks for both bias and precision, and diagnostic checks. All the instruments are connected on line to an instrument-control computer to which the measurement results can be communicated. Level 2 MC analyses are performed at this computer. The analyses consist of control charts for bias and precision and statistical tests used as analytic supplements to the control charts. They provide the desired detection sensitivity and yet can be interpreted quickly and easily. Recommendations are also made in terms of the frequency of the tests, the standard used, and other operational aspects of the MC program. 16 refs., 11 figs., 10 tabs.

34697 **(LA—10978-M) Procedures for PuO_2 field measurements with an HLNC-II.** Whan, G.A. (Los Alamos National Lab., NM (USA)). May 1987. Contract W-7405-ENG-36. 82p. (ISPO—276). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009484.

An upgraded version of the high-level neutron coincidence counter (HLNC-II) has been designed with faster electronics, higher counting efficiencies, a more uniform counting response within the sample cavity, and improved ruggedness and portability. These procedures describe the assay of PuO_2 powder for plutonium mass using the new HLNC-II along with the JOMAR JSR-11 electronics package, a Hewlett-Packard HP-85B computer, and the CC12 computer program.

34698 **(LA-UR—87-1279) Laser-induced breakdown spectroscopy: A new technique for nondestructive analysis of solutions.** Gutmacher, R.G.; Cremers, D.A.; Wachter, J.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870519—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008999.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

Laser-induced breakdown spectroscopy has been applied to the continuous determination of uranium in solutions. The technique is rapid, non-invasive, and unaffected by radioactivity. Powerful laser pulses are focused through an optical access onto the solution surface to produce a hot spark plasma. In experiments on static solutions, uranium concentrations between 0.1 and 300 g/L were determined, using a pulsed Md:YAG laser and a time-gated photodiode array. A concentration of 4.2 g/L was measured with 1.0% precision in 3 minutes. Substances that absorb at the laser wavelength, suspended materials, and variations in the acidity of the solution have little or no effect on the results. Experiments are in progress on flowing streams contained in a test loop that simulates plant operating conditions. 1 ref., 3 figs., 3 tabs.

34699 **(LA-UR—87-1504) NDA [nondestructive assay] training for new IAEA inspectors at Los Alamos.** Stewart, J.E.; Reilly, T.D.; Belew, W.; Woelfl, E.; Fager, J. (Los Alamos National Lab., NM (USA); International Atomic Energy Agency, Vienna (Austria)). 1987. Contract W-7405-ENG-36. 7p. (CONF-870519—6). NTIS, PC A02. File Number DE87010101.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

The history of the evolution of nondestructive assay (NDA) training for international inspectors at Los Alamos is described. The current NDA training course for International Atomic Energy Agency inspectors is presented in terms of structure, content, and rationale. Results of inspector measurement exercises are given along with projections for future developments in NDA inspector training. 3 refs.

34700 **(MLM—3438(OP)) The large volume radiometric calorimeter system: A transportable device to measure scrap category plutonium.** Duff, M.F.; Wetzel, J.R.; Breakall, K.L.; Lemming, J.F. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 5p. (CONF-870519—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010369.

From 9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management; London, UK (12 May 1987).

An innovative design concept has been used to design a large volume calorimeter system. The new design permits two measuring cells to fit in a compact, nonevaporative environmental bath. The system is mounted on a cart for transportability. Samples in the power range of 0.50 to 12.0 W can be measured. The calorimeters will receive samples as large as 22.0 cm in diameter by 43.2 cm high, and smaller samples can be measured without lengthening measurement time or increasing measurement error by using specially designed sleeve adapters. This paper describes the design considerations, construction, theory, applications, and performance of the large volume calorimeter system. 2 refs., 5 figs., 1 tab.

34701 **(NUREG/CR—4773) Design features to facilitate international safeguards at mixed-oxide conversion facilities.** Harms, N.L.; Roberts, F.P. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safeguards). Jun 1987. Contract AC06-76RL01830. 43p. (PNL—5894). NTIS, PC A03/MF A01 - GPO. File Number TI87010958.

This study for the Nuclear Regulatory Commission identifies and analyzes facility designs that can facilitate International Atomic Energy Agency safeguards for mixed plutonium uranium oxide (MOX) conversion plants. A baseline facility is defined and the implementation of safeguards is analyzed. Areas are identified for which special facility design considerations can facilitate IAEA inspections for timely detection of possible diversion of nuclear material. Design features are proposed to enhance inspection capabilities for verification of nuclear material flows and inventories. 17 refs., 2 figs., 6 tabs.

34702 **(SAND—86-2912C) Insider physical protection technology.** Trujillo, A.A.; Waddoups, I.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870743—2). NTIS, PC A02. File Number DE87007680.

From Carnahan conference on security technology; Atlanta, GA, USA (15 Jul 1987).

Since its inception, the nuclear industry has been engaged in providing protection against an insider threat. Although insider protection activities have been fairly successful in the past, present societal conditions require increased protection to further minimize the existence of an insider or the consequences of an insider-perpetrated incident. Integration of insider protection techniques into existing administrative and operational procedures has resulted in economic and operational impacts. Future increases in insider protection may result in even greater impacts, so we must proceed wisely as new approaches are developed. Experience ranging from operational test and evaluation of developmental equipment to concep-

tual designs for new facilities has led to the development of general principles and conclusions for mitigating the insider threat while minimizing adverse impacts on site operations. These general principles and the technology used and/or developed to implement the principles will be discussed.

34703 **(SAND—86-2949C) The SAVI [systematic analysis of vulnerability to intrusion] vulnerability assessment model.** Winblad, A.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870713—7). NTIS, PC A02. File Number DE87010736.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

The assessment model "Systematic Analysis of Vulnerability to Intrusion" (SAVI) presented in this report is a PC-based path analysis model. It can provide estimates of protection system effectiveness (or vulnerability) against a spectrum of outsider threats including collusion with an insider adversary. It calculates one measure of system effectiveness, the probability of interruption P(I), for all potential adversary paths. SAVI can perform both theft and sabotage vulnerability analyses. For theft, the analysis is based on the assumption that adversaries should be interrupted either before they can accomplish removal of the target material from its normal location of removal from the site boundary. For sabotage, the analysis is based on the assumption that adversaries should be interrupted before completion of their sabotage task 3. refs., 9 figs.

34704 **(SAND—86-2987C) Safeguards seals activities update.** Waddoups, I.G.; Rao, M. (Sandia National Labs., Albuquerque, NM (USA); USDOE, Washington, DC). 1987. Contract AC04-76DP00789. 5p. (CONF-870713—8). NTIS, PC A02. File Number DE87010955.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Ongoing commercial developments, some Department of Energy (DOE) contractor-initiated developments, and the desire to standardize seals and procedures stimulated the establishment of a seals task force to assess the current seals situation, develop reference material to assist in standardization, and recommend appropriate long-term activities. This paper summarizes the results of the task force effort and briefly discusses some of the more recent domestic seals developments.

34705 **(SAND—87-0025C) Valve position monitoring devices.** Pierce, L.L.; Hoover, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 2p. (CONF-870713—5). NTIS, PC A02. File Number DE87010734.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Sandia National Laboratories of Albuquerque, New Mexico, is the physical protection research and development lead laboratory for the US Department of Energy (DOE). A research project was initiated to provide devices for monitoring components vital to the safe and secure operation of a facility and to conduct a survey for the availability of valve monitors from commercial sources.

34706 **(SAND—87-0026C) Technology development for insider protection.** Waddoups, I.G.; Ortiz, S.; Trujillo, A.A. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 4p. (CONF-870713—4). NTIS, PC A02. File Number DE87010745.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Available technology has been applied to observing personnel and material movements as a means for providing earlier detection of errant insider activities. A demonstration system utilizing proximity badges, bar codes, and dynamic tamper indicators has been installed and evaluated for effectiveness in monitoring personnel and item movements. The dynamic tamper indicators were also installed at another facility to evaluate their effectiveness as both an insider protection element and a near real-time item inventory monitor. Studies to support these and other applications confirm that the manner in which cost effective insider protection can be provided is much more site-specific than are outsider protection schemes.

34707 **(SAND—87-0822C) Air flow studies for personnel explosives screening portals.** Schellenbaum, R.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870743—1). NTIS MF A01; 2; GPO Dep. File Number DE87007772.

From Carnahan conference on security technology; Atlanta, GA, USA (15 Jul 1987).

An explosives vapor detection method is under development to search personnel for contraband explosives in a portal configuration. In this, the explosives vapor diffusing through an individual's clothing is collected and identified. This process consists of three phases: (1) the efficient collection of the explosives vapor from the subject's body with minimum dilution; (2) the "preconcentration" of explosives molecules into a smaller, more concentrated volume; and (3) analysis by a sensitive detector. An Ion Track Instruments preconcentrator and a Phemto-Chem 100 Ion Mobility Spectrometer detector were employed in these explosive vapor flow studies. Extremely high system sensitivity is required (approximately 1 part per 10^{14}) because of the very low vapor pressure of many explosives, the very short search times allotted for suitable throughput (6 to 15 seconds), and dilution during collection. Experimental portal configurations were semi-laminar downward flow, upward flow, complete mixing of air within the portal, and sideways flow in a modified XonTech portal. Standard explosive samples were 10 grams of DNT or 0.5 gram of TNT in a small plastic bag placed in various positions on a mannequin in the portal. The most effective air flow and collection method was a downward, semi-laminar flow over the body cross-sectional area combined with a vacuum flow collection funnel of about 12 inches diameter beneath the grating floor of the portal. The average improvement in detection of the downward flow over complete mixing in the portal was a factor of 5. The side flow portal is nearly equivalent in efficiency but is lower in some extreme mannequin sample positions by a factor of about 2. 4 figs.

34708 **(SAND—87-0948C) Mobile robot vehicles for physical security.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 4p. (CONF-870713—2). NTIS, PC A02. File Number DE87010514.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

A fleet of vehicles is being developed and maintained by Sandia National Labs for studies in remote control and autonomous operation. These vehicles range from modified commercial vehicles to specially constructed mobile platforms and are utilized as test beds for developing concepts in the application of robotics to interior and exterior physical security. Actuators control the vehicle speed, brakes, and steering through manual input from a remote driving station or through some level of digital computer control. On-board processing may include simple vehicle control functions or may allow for unmanned, autonomous operation. Communication links are provided for digital communication between control computers, television transmission for vehicle vision, and voice for local control. With these vehicles, SNL can develop, test, and evaluate sensors, processing requirements, various methods of actuator implementation, operator controlled feedback requirements, and vehicle operations. A description of the major features and uses for each of the vehicles in the fleet is provided. 4 refs., 1 fig., 1 tab.

34709 **(SAND—87-0950) VISDTA: A video imaging system for detection, tracking, and assessment: Prototype development and concept demonstration.** Pritchard, D.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011580.

It has been demonstrated that thermal imagers are an effective surveillance and assessment tool for security applications because: (1) they work day or night due to their sensitivity to thermal signatures; (2) penetrability through fog, rain, dust, etc., is better than human eyes; (3) short or long range operation is possible with various optics; and (4) they are strictly passive devices providing visible imagery which is readily interpreted by the operator with little training. Unfortunately, most thermal imagers also require the setup of a tripod, connection of batteries, cables, display, etc. When this is accomplished, the operator must manually move the camera

back and forth searching for signs of aggressor activity. VISDTA is designed to provide automatic panning, and in a sense, "watch" the imagery in place of the operator. The idea behind the development of VISDTA is to provide a small, portable, rugged system to automatically scan areas and detect targets by computer processing of images. It would use a thermal imager and possibly an intensified day/night TV camera, a pan/ tilt mount, and a computer for system control. If mounted on a dedicated vehicle or on a tower, VISDTA will perform video motion detection functions on incoming video imagery, and automatically scan predefined patterns in search of abnormal conditions which may indicate attempted intrusions into the field-of-regard. In that respect, VISDTA is capable of improving the ability of security forces to maintain security of a given area of interest by augmenting present techniques and reducing operator fatigue.

34710 **(SAND—87-1037C) [Preliminary field evaluation of solid state cameras for security applications].** (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-870713—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010777.

From 28. INMM annual meeting on safeguards: a mature technology; Newport Beach, CA, USA (12 Jul 1987).

Recent developments in solid state imager technology have resulted in a series of compact, lightweight, all-solid-state closed circuit television (CCTV) cameras. Although it is widely known that the various solid state cameras have less light sensitivity and lower resolution than their vacuum tube counterparts, the potential for having a much longer Mean Time Between Failure (MTBF) for the all-solid-state cameras is generating considerable interest within the security community. Questions have been raised as to whether the newest and best of the solid state cameras are a viable alternative to the high maintenance vacuum tube cameras in exterior security applications. To help answer these questions, a series of tests were performed by Sandia National Laboratories at various test sites and under several lighting conditions. In general, all-solid-state cameras need to be improved in four areas before they can be used as wholesale replacements for tube cameras in exterior security applications: resolution, sensitivity, contrast, and smear. However, with careful design some of the higher performance cameras can be used for perimeter security systems, and all of the cameras have applications where they are uniquely qualified. Many of the cameras are well suited for interior assessment and surveillance uses, and several of the cameras are well designed as robotics and machine vision devices.

34711 **(SAND—87-1225) Technology assessment for command and control of teleoperated vehicles.** McGovern, D.E. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010990.

This paper reviews results in the area of driving studies, simulator applications and vision limitations to approach an understanding of the state of the technology of command and control requirements for teleoperation of mobile vehicles. From this review, a number of significant questions that have a direct bearing on the limits of performance and controllability are identified. These questions include acuity/resolution requirements and limits, monocular versus binocular viewing systems, color or black and white presentation, visual accommodation and magnification effects, training requirements, and the contribution of kinesthetic feedback (motion) to operation. These questions represent limits on the present state of the technology and are identified as areas requiring investigation and development. 32 refs., 26 figs., 3 tabs.

34712 **Concepts for advanced MC and A systems.** Markin, J.T.; Strittmatter, R.B.; Vaccaro, H.S.; Whitty, W.J. (Safeguards Systems Group, Los Alamos National Lab., Los Alamos, NM). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 2, 48-54(Jan 1987).

Modern approaches to nuclear materials safeguards have significantly increased the data processing needs of safeguards information systems. This report discusses several ongoing efforts at Los Alamos National Laboratory in the areas of automated detection and resolution of data errors, voice recognition for data entry, and distributed processing system design as applied to nuclear materials safeguards information systems.

34713 **Nuclear safeguards: Maintaining the balance.** *Journal of the Institute of Nuclear Materials Management;* **15**: No. 1, 37-47(Oct 1986).

This paper presents the remarks made at a forum on the political and technological aspects of nuclear materials management. Topics considered at the forum included US DOE safeguard recommendations, the POTAS program of international safeguards, US NRC safeguards, inspection, terrorism, national security, and nuclear materials diversion.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 34624, 34627

34714 (CONF-870245—, pp 139-147) **ORNL Remedial Action Program: responding to RCRA 3004(u) regulations.** Myrick, T.E. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Over the past several years, significant environmental legislation has been enacted at both the state and federal levels in the attempt to provide appropriate controls over the cleanup of contaminated sites. Of particular interest to the ORNL Remedial Action Program (RAP) is specific guidance that has been provided for surface impoundments and underground storage tanks. In addition, more general requirements have been put forth to cover assessment and corrective actions for any facilities that are found to be continuing sources of contaminant release to the environment [the 3004(u) provision of RCRA]. In keeping with the DOE policy of controlling the potential hazards associated with operation of the ORNL facilities, site remedial actions will be conducted, where appropriate, to meet these requirements and to ensure adequate protection of on-site workers, the public, and the environment. Implementation of the RAP at ORNL begins with identification of sites requiring corrective actions and will end with final certification of site closure or decommissioning activities. Between these two milestones is a structured path of program planning, site characterizations, alternatives assessments, technology demonstrations, continued maintenance, and necessary interim corrective actions.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

REFER ALSO TO CITATION(S) 35316

0702 Radiation Sources

34715 **(AD-A—178481/8/XAB) Dose-enhancement effects in the Aerospace Corporation Co-60 irradiator. Technical report.** Zietlow, T.C. (Aerospace Corp., El Segundo, CA (USA). Electronics Research Lab.). 17 Mar 1987. 26p. (TR—0086(6925-07)-6). NTIS, PC A03/MF A01.

The magnitude of the low-energy component of the radiation energy spectrum inside The Aerospace Corporation Co-60 irradiator was determined. Thermoluminescent detectors and a specialized ionization gage were used to verify the usefulness of a lead (0.06) and aluminum (0.03) sample shielding box to harden the Co-60 photon energy spectrum. The area of uniform dose as a function of distance from the Co-60 source inside the irradiator was also determined. Results suggest two recommendations for use of the irradiator: The Pb/A1 box should be used for all irradiated samples where low-energy radiation can be a factor, and samples should be placed as close to the source as possible, within the constraints of a homologous radiation field.

34716 **(IFE/KR/E—86/006) Measurement of neutron absorption cross section of rocks.** Andersen, E.; Loevhoeiden, G. (Institute for Energy Technology, Kjeller (Norway)). Nov 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752183.

At present, virtually no experimental information on neutron absorption cross sections of sediments in the North Sea is available. As this physical quantity gives valuable insight into important elements in the geological structure of sediments, and are essential for a reliable interpretation of pulsed neutron logs, an increased demand for measured neutron cross sections may be forseen. A steady state neutron source method is therefore tested to measure the neutron absorption cross section in royer dolomite, dunite, clashach sandstone and Norfloat quartz sand relative to Ottawa sand. The obtained values are in good agreement with measurements performed in other laboratories with various methods.

34717 **(ORNL/TM—10394) Extraction of gadolinium from high flux isotope reactor control plates.** Kohring, M.W. (Oak Ridge National Lab., TN (USA)). Apr 1987. Contract AC05-84OR21400. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87008559.

Gadolinium-153 is an important radioisotope used in the diagnosis of various bone disorders. Recent medical and technical developments in the detection and cure of osteoporosis, a bone disease affecting an estimated 50 million people, have greatly increased the demand for this isotope. The Oak Ridge National Laboratory (ORNL) has produced ^{153}Gd since 1980 primarily through the irradiation of a natural europium-oxide powder followed by the chemical separation of the gadolinium fraction from the europium material. Due to the higher demand for ^{153}Gd, an alternative production method to supplement this process has been investigated. This process involves the extraction of gadolinium from the europium-bearing region of highly radioactive, spent control plates used at the High Flux Isotope Reactor (HFIR) with a subsequent re-irradiation of the extracted material for the production of the ^{153}Gd. Based on the results of experimental and calculational analyses, up to 25 grams of valuable gadolinium (≧60% enriched in ^{152}Gd) resides in the europium-bearing region of the HFIR control components of which 70% is recoverable. At a specific activity yield of 40 curies of ^{153}Gd for each gram of gadolinium re-irradiated, 700 one-curie sources can be produced from each control plate assayed.

08 Properties

REFER ALSO TO CITATION(S) 35176

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 34469, 34738, 34741, 34742, 34750, 35065, 35112

34718 **(NP—7752438) Calculating the share of process energy consumed by biomass conversion plants.** Goebel, W. (Eidgenoessische Forschungsanstalt fuer Betriebswirtschaft und Landtechnik, Taenikon (Switzerland)). Jun 1984. 6p. (In German). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752438.

During the winter season the process energy consumption of biomass conversion plants is relatively high. Apart from the quantity and temperature of manures and insulation of the fermentation tank the process energy consumption depends on the efficiency of the heating system. Moreover, heat losses decide on the required quantities of process energy. Compared with the process energy consumption the electric power consumption of the engines supplying the biomass conversion plant is relatively low. Along with calculations tests and measurements in a biomass conversion plant during the winter season of 1981/1982 give access to the interrelation between process energy and electric power consumption.

34719 (NP—7752440, pp 63-89) **Biogas in agriculture - report on the symposium held in Vienna and Graz from 16th to 18th April, 1986.** Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

A research programme for the utilization of biogas in agriculture was implemented within the framework of research into raw materials and energy in Austria. The results may be summarized as follows: The biotechnological and microbiological fundamentals of the process were determined. Biogas plants are a complex technical system which will not be profitable to date if operated as a single unit and mathematical models for the total process were developed which may be used for the design and optimization of plants.

34720 (NP—7752440, pp 92-94) **Simple analysis methods for biogas plants: Second research stage.** Spitzer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

Simple analysis methods were developed, which will allow biogas plant users to analyse the operational state and to initiate corresponding measures. An operating manual was produced to secure correct application of the analytical devices. This manual contains the instructions for the execution and evaluation of measurements for determining the operational state of a biogas plant.

34721 (NP—7752440, pp 95-96) **Maintenance/optimization of the Harrer/Trummer biogas plants.** Spitzer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

This project report contains a brief description of each of the two biogas plants and summarizes the experience gained in their operation and the optimization measures effected correspondingly.

34722 (NP—7752440, pp 97-99) **Liquid manure/liquid manure heat exchanger: Testing the prototype.** Spitzer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

A prestudy funded by the Land Steiermark covered 7 different heat exchanger systems which were examined for their technology and profitability. Two out of these systems ('upstream-storage-tank heat exchanger without mixer' and 'coiled-tube heat exchanger') were built as prototypes within the project and tested at the Edelhof biogas research and demonstration centre (Lower Austria). The measurement results suggest that an efficiency of almost 50% may be achieved if and when the heat exchanger has an optimum design. Heat exchanger cost strongly depend from the specific conditions resulting from the integration of the heat exchanger arrangement in the digester so that general statements on these cannot be made. That is why a generally valid statement on the profitability of the heat exchanger was not made either.

34723 **(PNL-SA—14672) An overview of biomass thermochemical liquefaction research sponsored by the US Department of Energy: 1987.** Stevens, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 7p. (CONF-870410—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010865.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Thermochemical conversion processes offer promising methods for converting biomass to gasoline-compatible liquid fuels. Thermochemical conversion processes employ elevated temperatures to convert the biomass feedstock. These processes can convert 85 to 95% of the organic material in such feedstocks with little sensitivity to variations in the feed material. Biomass direct liquefaction process are those which produce liquids as primary initial products, usually at moderate temperatures (250 to 600°C). Pyrolytic and catalytic liquefaction processes which produce biocrude oils are examples. The biocrude oils would be suitable for some uses as produced or for upgrading into gasoline-compatible fuels. In this paper an overview of biomass direct liquefaction research being sponsored by the US Department of Energy's Biomass Thermochemical Conversion Program is presented. 6 refs., 4 figs., 3 tabs.

34724 **Studies of secondary processes involving low-molecular weight olefins occurring during Fischer Tropsch synthesis.** Jordan, D.S.; Bell, A.T. New York, NY; American Institute of Chemical Engineers (1986). 4p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

The objectives of this study were to investigate the influence of ethylene addition on the hydrogenation of CO over Ru/SiO/sub 2/ and to compare the product distribution obtained with those for CO hydrogenation in the absence of ethylene and ethylene homologation in the absence of CO. To enable identification of the source of carbon in the products, /sup 13/C-labeled CO and unlabeled C/sub 2/H/sub 4/ were used. Products were analyzed by isotope-ratio gas chromatography-mass spectrometry. Among the issues investigated were the influence of ethylene addition on the reactions of CO and the participation of ethylene in processes of hydrocarbon chain initiation and growth. The influence of ethylene addition on methane formation was also examined.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 35096

34725 **(DOE/PC/80536—T6) A new method of magnetic characterization of zeolite-cobalt catalysts: Quarterly technical progress report No. 6, February 1, 1987 through May 30, 1987.** (Grambling State Univ., LA (USA)). 30 Jun 1987. Contract FG22-85PC80536. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011339.

An empirical method of analysis of the line intensities provides not only a uniform basis for comparing the spectra of different samples, but also lends itself for quantitative estimation of (1) particle size distribution, (2) actual amount of multi-domain phase material (M/sub md/) present in a given sample, and (3) how this material is distributed among the different crystallite species (P/sub md/) such as FCC, fault structures, and HCP etc. in the sample. Coupled with the state of reduction data from magnetic susceptibility measurements NMR could provide a complete species characterization of the catalyst sample. The NMR data for physically admixed (PA), aqueous (AQ) and acetone (AC) impregnated cobalt - ZSM-5 catalysts before and after catalysis is presented in Table I and Figures II and III. The figures display the distribution of unit mass of multi-domain species (particles with size >150°A) of cobalt metal among different crystallite structures such as FCC, HCP or faulted FCC and HCP structures. One striking feature that clearly emerges is that in the commercial sample FCC structure predominates, while in the precipitated and supported catalysts it is the least preferred structure. Another strong characteristic of the catalysts is the consistent absence of HCP line and preference to a faulted HCP structure at 221.6 +- 0.3 MHZ, almost 0.6 MHZ above the normal HCP phase (221 MHZ). However, if the metal loading is low for physically admixed and acetone impregnated catalysts, the sample is uniformly distributed among all the structures while the original trend persists for aqueous impregnation. Another noteworthy feature is that the process of catalysis tends to bring about this uniform distribution more strongly except in the 9% physically admixed and aqueous impregnation catalysts.

34726 **(PB—87-173084/XAB) Synthesis of methanol in a gas-solid-solid trickle flow reactor. Doctoral thesis.** Kuczynski, M. (Technische Hogeschool Twente, Enschede (Netherlands)). 27 Jun 1986. 86p. NTIS, PC PC E04/MF E01.

The Gas-Solid-Solid Trickle Flow (GSSTF) principle is an extension of the well known Gas-Solid Trickle Flow principle applied to systems involving a heterogeneous reaction. In the GSSTF reactor studied here, there are three active phases: a gas, containing reactant(s) and product(s), a solid being the reaction catalyst, and another solid, being the product adsorbent. In the thesis several aspects of the applicability of this reactor type to heterogeneously catalyzed gas reactions are presented. The case of the low-pressure methanol synthesis is discussed in detail. In Chapter I the properties of the adsorbent chosen are discussed. As methanol adsorbent, the fluidizable LAC-25 low-alumina cracking catalyst of AKZO Amsterdam was selected. The hydrodynamic behavior of the GSSTF reactor was studied and is discussed in Chapter II. In Chapter III the catalyst properties are discussed. In Chapter IV a steady state model is developed for the GSSTF reactor and is applied for the case of the methanol synthesis. Chapter V deals with the miniplant operated in the high-pressure laboratory. The methanol synthesis in the GSSTF reactor was studied experimentally in a high-pressure miniplant.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 34747

34727 (NP—7752440, pp 57-59) **Report on the operating experience with wood firing systems.** Spitzer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The report states summarily that users view wood firing systems as a genuine alternative to the oil and coal firing systems used before: despite various problems and a rather high number of operators complaining a loss of comfort in handling as against oil firing systems, most users are highly satisfied with the systems currently in operation. Obtaining problems are not felt to be too burdensome as a rule. Each drawback, however, is contrasted by a benefit from the user's point of view which often as not is a truly personal one (e.g. grid firing has many problems but low cost). Increasing demand and resulting technological further development of automatic-feed wood firing systems strongly suggest increased application of wood as fuel in the future.

34728 **Densified refuse-derived fuel - An alternative energy source.** Ohlsson, O.; Daugherty, K.E.; Venables, B.J. (Argonne National Lab.). pp 593-597 of Strategies for energy efficient plants and intelligent buildings. Atlanta, GA; Association of Energy Engineers (1986). (CONF-861033—).

From 9. world energy engineering congress; Atlanta, GA, USA (21 Oct 1986).

The objective of this research effort is to produce an environmentally acceptable, chemically/biologically stable, and storable densified refuse derived fuel (dRDF) pellet. To accomplish this, a suitable binder(s) must be used. Over 150 binders were investigated by a laboratory screening procedure. Thirteen binder/binder combinations of the initial group of 150 binders were selected for further pilot plant studies. Approximately seven tons of RDF from Ames, Iowa and Refcom, Pompano Beach, Florida were pelletized in the summer-1985 in a series of experiments at the Jacksonville, Florida Naval Air Station using these binders. The pelletized dRDF was then subjected to a batter of chemical and physical tests. Results to date and work to be accomplished during the next fiscal year are discussed.

13 HYDRO ENERGY

1303 Plant Design And Operation

34729 (DOE/BP/22105—1) Installation of a marine thruster as a hydroelectric turbine at Eagle Creek National Fish Hatchery: Final report. (Bonneville Power Administration, Portland, OR (USA)). 15 Nov 1986. Contract FC79-85BP22515. 195p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87009359.

A 70kW hydroelectric plant utilizing a marine thruster and an induction generator was commissioned on May 15, 1985 at the Eagle Creek National Fish Hatchery near Estacada, OR as a Bonneville Power Administration (BPA) demonstration project. The marine thruster, normally used to maneuver large ships, was run "backwards" to produce electricity. The plant was completed and tested by J.F. Sato and Associates, Inc. (JFSA). The marine thruster was seen as a method for reducing the capital cost of small, low head hydro projects by utilizing readily available, off-the-shelf equipment. The owner of the hatchery, the US Fish and Wildlife Service (USF and WS), has an active energy conservation program and looked hopefully at a match of inexpensive hydroelectric technology and an available site at the hatchery to offset their annual 650,000-kWh usage. The preliminary results of the testing program indicated a water-to-wire efficiency in the mid-70 percent range and a turbine efficiency in the low-80 percent range. Total gross head was 19 feet with a maximum flow of 65 cubic feet per second. The unit was tested at four different speeds by varying sheave diameters on the drive system. Flow measurements were taken using the Venturi principle at a reducer in the penstock. A downstream weir was constructed to correct low tailwater conditions. 7 refs., 44 figs., 11 tabs.

1305 Economics And Management

REFER ALSO TO CITATION(S) 34729

34730 (PB—87-161162/XAB) Decentralized hydropower in AID's (Agency for International Development's) development assistance program. (National Rural Electric Cooperative Association, Washington, DC (USA)). Jan 1986. 66p. NTIS, PC A04/MF A01.

The report discusses the rationale for the U.S. Agency for International Development (AID's) interest in decentralized hydropower (DH), the state-of-the-art technology, and the lessons learned from past experience on how such a technology can best be implemented. AID's Office of Energy will serve as a catalyst to DH development by conducting reconnaisance and prefeasibility analyses to identify potential sites for cost-effective applications and then brokering these sites by bringing together potential developers to assume responsibility for planning, financing, construction, and operation, with only minor additional assistance from AID. DH will be included as a key energy option in AID projects to ensure that DH is evaluated wherever it can meet power needs and to identify those applications where it is the best option.

1306 Environmental Aspects

REFER ALSO TO CITATION(S) 34729, 35784, 35785

34731 (DOE/BP—756) Pacific Northwest Rivers Study: Assessment guidelines: Montana. (Montana Dept. of Fish, Wildlife and Parks, Helena (USA)). Mar 1987. 126p. NTIS, PC A07. File Number DE87011160.

This document presents the process that participants followed to complete the Pacific Northwest Rivers Study. It identifies assessment guidelines for each river resource category and provides reporting formats for data collection and presentation. The specific purpose was to identify resource considerations which might affect hydropower development. The objective is to use this information to identify areas where minimal impact can be anticipated and thus where development might be appropriate. The categories included resident fish, wildlife, natural features, recreation, cultural features, and institutional constraints.

34732 (DOE/BP—758) Pacific Northwest Rivers Study assessment guidelines: Washington State. Zubalik, S. (comp.). (USDOE Bonneville Power Administration, Portland, OR). Dec 1986. Contract AI79-84BP19369. 82p. (WAGENG—87-03). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011161.

This document describes the process that participants followed to complete the Pacific Northwest Rivers Study. It identifies assessment methods for each river resource categories, the types of data collected, and the criteria for the evaluation and ranking of river reaches. The purpose of the project was to identify resource considerations which might affect hydropower development. The goal was to evaluate and document the significance of individual river segments and systems for a variety of natural resource. Comparative assessment was a major feature of this process. The process did not, however, result in rivers being ranked in numerical order. Rather, each stream reach was given one of four significance ratings for each of five resource categories along with ranking of land-use restrictions which would affect hydroelectric development. The categories selected included resident fish, wildlife, natural features, recreation, cultural features, and institutional constraints. Anadromous fish and tribal cultural and archeological values were included through a separate NPPC contract.

34733 (DOE/BP/20733—2) Monitoring of downstream salmon and steelhead at federal hydroelectric facilities, 1986: Annual report. Johnsen, R.C.; Wood, L.A.; Smith, W.W. (National Marine Fisheries Service, Portland, OR (USA). Environmental and Technical Services Div.). Mar 1987. Contract AI79-85BP20733. 54p. NTIS, PC A04. File Number DE87009922.

The 1986 smolt monitoring project provided data on the seaward migration of juvenile salmon and steelhead at Lower Granite, Lower Monumental, McNary, John Day, and Bonneville Dams. The number of fish sampled by species, brand recaptures, and pertinent flow data were provided for the purpose of evaluating smolt survival, travel time, and migrational timing.

34734 (DOE/BP/35097—4) Preliminary estimates of loss of juvenile anadromous salmonids to predators in John Day Reservoir and development of a predation model. Rieman, B.E.; Beamesderfer, R.D.; Nigro, A.A.; Vigg, S.; Handel, H.C.; Palmer, D.E. (Oregon Dept. of Fish and Wildlife, Clackamas, OR (USA); Fish and Wildlife Service, Cook, WA (USA). Willard Field Station). Mar 1986. Contract AI79-82BP35097;AI79-82BP34796. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010557.

We made preliminary estimates of the loss of juvenile salmonids to predation by walleye, Stizostedion v. vitreum, and northern squawfish, Ptychocheilus oregonensis, in John Day Reservoir in 1984 and 1985 using estimates of predator abundance and daily prey consumption rates. Preliminary estimates may be biased and may be adjusted as much as 30%, but indications are that predation could account for the majority of unexplained loss of juvenile salmonids in John Day Reservoir. Total loss was estimated at 4.1 million in 1984 and 3.3 million in 1985. Northern squawfish consumed 76% and 92% of these totals, respectively. The majority of loss occurred in mid reservoir areas, but loss in a small area, the boat-restricted zone immediately below McNary Dam, was disproportionately large. Peaks in loss in May and July corresponded with peaks in availability of salmonids. Estimated mortality from predation for April through June in 1984 and 1985 was 9% and 7% respectively, for chinook salmon, Oncorhynchus tshawytscha, and 10% and 15% for steelhead, Salmogairdneri. Mortality was variable with time but tended to increase over the period of migration. Mortality of chinook was estimated at 26% to 55% during July and August. A model of predation in John Day Reservoir is outlined. The model includes a predation submodel that can calculate loss from predator number and consumption rate; a population submodel that can relate predator abundance and population structure to recruitment, exploitation, natural mortality and growth; and a distribution submodel that can apportion predators among areas of the reservoir over time. Applications of the model are discussed for projecting expected changes in predation over time and identifying management alternatives that might limit the impact of predation.

34735 (DOE/BP/61982—T1) Stream habitat enhancement evaluation workshop: A synthesis of views: Level I workshop: March 1986, Hood River, Oregon. Buell, J.W. (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Dec 1986. Contract AP79-86BP61982. 93p. NTIS, PC A05/MF A01. File Number DE87009903.

The report presents philosophies and approaches for the design and conduct of stream habitat enhancement evaluation programs and projects. (ACR)

34736 (EPRI-EA—5200-Vol.3) Compensatory mechanisms in fish populations: Literature reviews: Volume 3, A critical review of mathematical models for fish compensation mechanisms: Final report. Chen, C.W. (Systech Engineering, Inc., Lafayette, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 245p. Research Repts. Center, Box 50490, Palo Alto, CA 94303. File Number TI87920449.

A critical review of population dynamics models was performed to describe previous models and to recommend approaches for future research on compensation in fish population. The models were first classified into five categories, i.e., theoretical, stock-recruitment, biomass (bioenergetic), population (number), and life cycle functions. Models in each category were then reviewed for their formulations, assumptions, limitations, and performances. A majority of the models were found to have been formulated to calculate parameters that could not be directly measured. Models developed to evaluate entrainment and impingement impacts were often applied without validation against observed data. To advance the scientific understanding of fish compensation mechanisms, future research should include complimentary studies in both model development and empirical observation. Modeling will provide a theoretical framework to integrate individual compensation mechanisms and to relate them to population level responses. Empirical observation, on the other hand, will furnish data to verify the theory. The fish compensation model should use a cohort representation that allows the incorporation of the relationships between life cycle processes and environmental conditions. Growth and mortality of fish in early life stages should be related to weather, hydrology, temperature and food in addition to competition and predation. Environmental data with an inherent stochasticity should be used as input to produce verifiable real time variations in year class strength.

14 SOLAR ENERGY

1401 Resources And Availability

34737 (SAND—87-1119C) Development of sizing nomograms for stand-alone photovoltaic/storage systems. Chapman, R.N. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 18p. (CONF-870711—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008929.

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

This paper described the development of a simplified technique for sizing stand-alone photovoltaic/storage systems. The sizing criterion is the long-term loss-of-load probability which is the fraction of the total energy demand that the photovoltaic system will not be able to satisfy over a 23 year period. The technique was derived using 23 years of hourly insolation data from 20 US weather stations. These data were used to develop correlations between the variability in insolation and average monthly horizontal insolation. The correlations were then used to generate sizing nomograms that give the array size as a function of average horizontal insolation and the storage capacity as a function of the long-term loss-of-load probability. The technique is valid for systems with a fixed tilt array, product or energy storage, and any hourly or daily demand profile provided that the average monthly demand does not vary by more than +-10% from month to month.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 34769

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 34525, 34718, 34719, 34720, 34721, 34722, 34723, 34727, 34728, 34779, 35067, 35259, 35350, 35788, 35851, 35855, 35891, 36088

34738 (CONF-850626—, pp 391-403) **Thermochemical breakthroughs.** Schiefelbein, G.F. (Pacific Northwest Lab., Richland, WA). Jun 1985. NTIS, PC A23/MF A01. File Number DE87008911. Contract AC06-76RL01830.

From Renewable energy technologies symposium and international exposition; Anaheim, CA, USA (3 Jun 1985).

Biomass offers excellent potential for increased energy impact in the future. Wood and crop residues constitute a vast majority of the biomass feedstocks available for conversion to higher valued energy products. Thermochemical processes are well suited for conversion of these materials. The author describes research sponsored by the DOE's Biomass Thermochemical Conversion Program, which includes work on direct combustion, gasification, and liquid fuels technology. Liquefaction includes pyrolytic and catalytic/solvolytic approaches to generating biocrude liquid fuels. The research activities seek to capitalize on the unique properties of biomass to produce a broad spectrum of competitive energy products. 20 references, 10 figures, 2 tables.

34739 (CONF-870523—2) An ASPEN simulation of fuel production by hydrolysis of woody biomass. Byers, C.H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010013.

From 9. symposium on biotechnology for fuels and chemicals; Boulder, CO, USA (5 May 1987).

An integrated process, in which woody biomass is converted to fuel, is simulated using the ASPEN simulator. For purposes of simulation, the process was divided into four sections; biomass refining, hydrolysis, bio-reaction and fuel separation. Detailed attention is paid to the hydrolysis process and the bio-reactor, while a general simulation of the front-end biomass refining process and fuel separation step at the end of the process is included. A simulation of the biomass and active microbial system required the definition of nonconventional streams. The emphasis in this study was upon the effect of varying acid recycle in the two step hydrolysis process. As the recycle ratio increases the operating cost of the overall process passes through a minimum. Suggestions for the refinement and extension of this approach are discussed. Its advantages in establishing the cost of proposed technologies, assessing areas where research and development and required and evaluating schemes for enhancing energy efficiency are all evaluated. 10 refs., 5 figs., 3 tabs.

34740 (CONF-8609286—Absts.) BIO Technica '86. Conference abstracts. (Deutsche Messe- und Ausstellungs-A.G., Hannover (Germany, F.R.)). 1986. 63p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

The conference papers deal with biotechnological processes in the field of medicine, foodstuffs, agriculture and environmental protection. Separate entries are available for six papers.

34741 (CONF-8609286—Absts., pp 3, Abstract 8) Biotechnology in the utilization of by-products. Litchfield, J.H. (Battelle Columbus Labs., OH, USA). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

Agricultural and food industry wastes generally contain carbohydrates (simple sugars, starches, pectins, and cellulose/hemicellulose/lignin), lipids, protein and non-protein nitrogen compounds

(amino acids, peptides, proteins, nucleic acids), organic acids, vitamins and pigments (carotenoids, anthocyanins). In liquid wastes, these substances may be presently only in small concentrations. In solid wastes, they may be entrapped within plant or animal cells. Under anaerobic conditions, wastes containing carbohydrates, lipids and proteins can be digested to yield methane and carbon dioxide. Recently developed improvements in anaerobic processes for methane production include upflow and downflow fixed film reactors which can achieve high productivity values in the range of 8m/sup 3//m/sup 3//d. Also, carbohydrates can be converted to ethanol or organic acids. Immobilized cell bioreactor technologies have enabled significant improvements in the productivity of these processes.

34742 (CONF-8609286—Absts., pp 3, Abstract 15) **Anaerobic treatment of agricultural wastes.** Troesch, W. 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

34743 **(CONF-8706127—1) Function of active-site residues of ribulose bisphosphate carboxylase/oxygenase.** Hartman, F.C.; Foote, R.S.; Larimer, F.W.; Lee, E.H.; Machanoff, R.; Milanez, S.; Mitra, S.; Mural, R.J.; Niyogi, S.K.; Smith, H.B. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011124.

From Plant molecular biology; Copenhagen, Denmark (10 Jun 1987).

As one facet of elucidating the mechanism of ribulose-P_2 carboxylase and of ultimately evaluating the feasibility of altering the carboxylase/oxygenase ratio, active-site characterization has received considerable attention. Chemical modification has revealed five disparate segments of primary structure that appear to constitute the active site. The amino acid sequence of each segment is highly conserved among evolutionarily diverse carboxylases. Site-directed mutagenesis has been used to clarify further the functions of Lys-166, Lys-329, His-291, and Glu-48 of ribulose-P_2 carboxylase from Rhodospirillum rubrum. These two lysines were selected for examination because of the wealth of data discussed earlier that had implicated their catalytic involvement. His-291 was scrutinized because of the suggestion of its participation, rather than Lys-166, as the proton transfer group that enolizes ribulose-P_2. The reasons for inspecting Glu-48 were circumstantial. Within the homologous region flanked by His-44 and Cys-58, targets of an affinity label, Glu-48 is the only acid/base group and hence a logical candidate for functionality. Furthermore, crystallographic and chemical cross-linking studies had placed this NH_2-terminal region near the active site. 33 refs.

34744 **(DOE/ER/13369—1) [Cloning, characterization and expression of genes encoding lignin peroxidases in Phanerochaete chrysosporium]: Performance report.** (Michigan State Univ., East Lansing (USA)). 1987. Contract FG02-85ER13369. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010747.

This document describes a year's research on this project's two primary objectives: cloning and characterization of cDNA for ligninase from the lignin degrading filamentous fungus Phanerochaete chrysosporium; and the isolation and characterization of mutants lacking glucose oxidase and/or ligninases. The research team constructed a cDNA library that contains 10,000 cDNA clones stored individually in 96-well microtiter plates. Further analysis identified 850 cDNA clones that were specific to mRNA from 6-day-cultures. This library should simplify isolation of the genes for ligninase and for other secondary metabolism genes. The group also sequenced completely the nucleotides of two types of ligninase cDNAs, and the corresponding ligninase proteins. The research team prepared a spheroplast transformation vector, an autonomous replication sequence, and a 2.2 kb PvuII fragment carrying a kan/sup r/ determinant from plasmid pNG35. Research on secondary metabolism led to the isolation of mutants defective in ligninase and glucose oxidase and to the purification and characterization of glucose oxidase. 10 refs., 6 figs., 2 tabs. (TEM)

34745 **(DOE/ER/13620—1) Particulate models of photosynthesis: Technical progress report for the period September 1, 1986 to April 30, 1987.** Seely, G.R. (Arizona State Univ., Tempe (USA). Dept. of Chemistry). Apr 1987. Contract FG02-86ER13620. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011073.

During the first few months of this project period, effort has been concentrated on the preparation of primary oxidants based on histamine, that is, molecules which will simultaneously adsorb to the surface of swollen polyethylene particles, ligate the Mg of chlorophyll, and accept an electron from photoexcited chlorophyll. The technique of measuring fluorescence yields in highly scattering samples has continued to be developed and improved. Fluorescence spectra and quantum yields for bacteriochlorophyll c in a number of solvents have been measured; the results are important for an understanding of energy transfer in green bacteria. 4 refs.

34746 **(DOE/OR/21390—13) Great Lakes Regional Biomass Energy Program: Quarterly report, September 1, 1986-November 30, 1986.** Bancroft, D. (Council of Great Lakes Governors, Inc., Madison, WI (USA)). May 1987. Contract FG05-83OR21390. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010700.

Stressing near-term biomass feedstock production techniques and conversion processes, the objective of the program is to increase the use of biomass energy by the public and private sectors in the Great Lakes region including Illinois, Indiana, Iowa, Michigan, Minnesota, Ohio and Wisconsin. The Great Lakes Regional Biomass Energy Program is divided into three separate operational programs. The first is the State Grant Program, which provides resources to the seven state energy offices in the region to increase their capabilities in biomass energy. State-specific activities and interagency programs are emphasized in the State Grant Program. The second, the Subcontractor Program, involves the letting of subcontracts to private organizations to address regional biomass issues and needs. The third is the In-House Technology Transfer Program in which Council staff develop biomass energy publications and reports. The primary activity this quarter has been information transfer. The program spearheaded an effort to reach the private sector and inform people about a wide range of biomass technologies. In one of the most successful events, 35 cheese manufacturers traveled to the South Alma Cheese Factory to see a woodburner supporting the process steam needs of the facility. In addition, 20 workshops were conducted throughout the region focusing on industrial wood combustion, municipal waste to energy incineration and short rotation forestry. 1 fig.

34747 **(EUR—10810-EN/IT) Baler for the harvesting without shredding of pruning-wood from vineyards and fruit trees in general. Demonstration project.** Grilli, W.; Muratori, L. (Commission of the European Communities, Luxembourg. Directorate General Information Market and Innovation). 1986. 36p. (In Italian). Commission of the European Communities, Luxembourg. Office of Official Publications of the European Communities.

Energy/Energia.

The machine under study was designed to harvest the pruning wood from vineyards and from fruit trees in general without shredding it, forming the cuttings into round bales which are easy to transport and to store, and which are practical for use as fuel for central heating on a farm or family level, or for the production of hot water or steam for use in food-processing industries, preferably near the zone of production. The made-up bales conserve the product well, and reduce to a minimum the loss of cuttings from baleends. The compact baler can be used for rows of varying widths, on different kinds of terrain, and for many different types of fruit trees as well.

34748 (NP—7752440, pp 51-56) **Energy forest III, report year 1985.** Unteregger, E. Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

This report is the continuation of the 1981/1982 final report and of the report covering the period from 1st May, 1983 to 31st October, 1984. It describes the continuation of the energy forest tests launched in 1980. This report gives an overview on the test areas and the measures performed in the reported year.

34749 (NP—7752440, pp 60-62) **Application potential of wood gasification plants in Austria.** Spitzer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The assessment of the micro-economic prerequisites reveals that wood gasification systems with gas burners will not be profitable below a fuel utilization output of 2,400 kW (c. 2,000 kW thermal output of the fluegases) and below a minimum annual operating period of 7,000 hours. Wood gasification systems in heat-and-power plants will not be profitable below an electric output of c. 600 kW and 1,250 kW thermal output of the hot water, and below a minimum annual operating period of 7,000 hours. The application potential of wood gasification systems, hence, must be seen in the wood-processing industry and - to a lesser extent - in the dairy and the building materials industry.

34750 (NP—7752440, pp 90-91) **Start-up processes in biogas plants: Second research stage.** Spitzer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

When cultivating Methanococcus vannielii with H/sub 2// CO/sub 2/, we succeeded in improving the gas input velocity (prerequisite for good growth) by varying the stirring motion and the gas throughput rate. Formic acid revealed to be the best substrate since it will cause no problems when used as an input and since the pH-shift can be used as a simple control parameter. In addition, substrate costs were much lower than those of H/sub 2//CO/sub 2/. The culture conditions excluded the growth of other anaerobic micro-organisms; hence, even non-sterile techniques allowed to produce cultures with a methane bacteria content of over 96%. In order to keep the start-up phase in the practical application of biogas plants as short as possible, sufficient quantities of inoculum (drains from other biogas systems, cattle manure or sewage sludge) will have to be used and fresh substrate supply will have to be increased under careful control.

34751 (SERI/CP—211-3090) **Abstracts of presentation: International conference on stability of amorphous silicon alloy materials and devices.** (American Inst. of Physics, New York; Solar Energy Research Inst., Golden, CO (USA); New Energy Development Organization, Tokyo (Japan)). 1987. Contract AC02-83CH10093. 136p. (CONF-870116—Summs.). NTIS MF A01; 2; GPO Dep. File Number DE87001122.

From International conference on stability of amorphous silicon alloy materials and devices; Palo Alto, CA, USA (28 Jan 1987).

The abstracts from the papers are presented in this document. The actual papers will be published as an American Institute of Physics Conference Proceedings.

34752 (SERI/STR—211-3030) **High-efficiency, cooper ternary, thin-film solar cells: Annual subcontract report, 1 May 1985 - 31 April 1986.** Kapur, V.K.; Basol, B.M.; Tseng, E.S. (International Solar Electric Technology, Inglewood, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). Feb 1987. Contract AC02-83CH10093. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001147.

A new, two-stage process for depositing $CuInSe_2$ films has been developed. In this method, copper and indium metal layers were sequentially electroplated onto a molybdenum-coated glass substrate with a fixed Cu/In ratio. This metal stack was selenized at 400°C under an atmosphere of H_2Se gas. Single-phase $InSe_2$ films thus obtained were used to fabricate $CuInSe_2$/CdS solar cells. Evaporated CdS films were used for device fabrication. Solar cells 1.0 cm^2 in area had a conversion efficiency in the range of 7.0% to 7.3% without an antireflection coating. Correcting for the reflective losses and the grid shading, the active area efficiency for these cells was projected to be around 10.0%.

34753 (SERI/STR—211-3031) **MOCVD techniques for cadmium telluride solar cells: Annual subcontract report, 15 February 1985 to 15 February 1986.** Schafer, D.E. (Solar Energy Research Inst., Golden, CO (USA)). Feb 1987. Contract AC02-83CH10093. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001154.

This report summarizes the application of metal-organic chemical vapor deposition (MOCVD) film-growth technique to two aspects of CdTe/ITO solar cell fabrication: the growth of large-area CdTe films on ITO and the formation of low-resistance ohmic contacts to p-type CdTe. In this work, uv-assisted MOCVD was developed for the deposition of CdTe films to lower the growth temperature and minimize the tendency of damage to the ITO layer. Also, MOCVD growth of HgTe was developed as an ohmic contact metallization to the CdTe layer of the photovoltaic structure. This report details the MOCVD reactor geometries and process parameters used in the development of the CdTe and HgTe layer growth, as well as the results of Auger analysis of layer composition and interlayer diffusion, x-ray analysis of film crystallinity, and electrical analysis of HgTe/CdTe specific contact resistance.

34754 **Current and lattice matched tandem solar cell.** Olson, J.M. (to Dept. of Energy, Washington, DC). US Patent 4,667,059. 19 May 1987. Filed date 22 Oct 1985. vp.

This patent describes a high-efficiency multijunction photovoltaic solar cell, comprising: a top semiconductor cell fabricated of GaInP/sub 2/ with a light-sensitive n/p homojunction therein for absorbing higher energy photons; a bottom semiconductor cell fabricated of GaAs with a light-sensitive n/p homojunction therein for absorbing lower energy photons; a low-resistance attachment between the top cell and the bottom cell wherein the GaInP/sub 2/ is lattice matched to the GaAs; and electrical contact means attached to opposite sides of the solar cell to conduct current away from and into the solar cell.

34755 **Status of DOE/SERI amorphous silicon research project.** Sabisky, E.S.; Wallace, W.; Stafford, B.; Luft, W. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 62-66 of Photovoltaics for commercial solar power applications. Adler, D. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8609127—). Contract AC02-83CH10093.

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

The Amorphous Silicon Research Project (ASRP) was established at the Solar Energy Research Institute (SERI) in 1983 and is responsible for coordinating all U.S. Department of Energy (DOE) research activities in amorphous silicon photovoltaics. The strategy, objectives, and research directions of the project have been established by a five-year research plan, which was published in 1984. The technical plan of the ASRP is organized into two principal activities: multidisciplinary activities and fundamental research activities. Near-term objectives (early 1987) for single-junction cells and submodules are efficiencies of 12% (for an area of 1 cm/sup 2/) and 8% (for 1000 cm/sup 2/), respectively; for multijunction cells, the near-term goal is an efficiency of 13% (for 1 cm/sup 2/).

34756 **Reliability of photovoltaic modules.** Ross, R.G. Jr. (Jet Propulsion Lab., 4800 Oak Grove Drive, Pasadena, CA 91109). pp 52-60 of Photovoltaics for commercial solar power applications. Adler, D. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-8609127—).

From SPIE symposium on optics and optoelectronics; Cambridge, MA, USA (14 Sep 1986).

As part of the U.S. National Photovoltaic Program, the Jet Propulsion Laboratory's (JPL's) Flat-Plate Solar Array (FSA) Project has conducted a comprehensive 10-year research activity addressed to understanding the reliability attributes of terrestrial flat-plate photovoltaic modules, and to developing the technology required to achieve 30-year life. This paper provides an overview of the reliability issues and progress, and highlights the design, analysis, and test tools generated to achieve the high levels of reliability necessary for future large-scale terrestrial applications. Much of the technology is also directly applicable to the large space arrays currently under consideration for use in extraterrestrial applications.

34757 **The growth of silicon ribbons for photovoltaics by edge-supported pulling.** Ciszek, T.F. (Solar Energy Research Institute, Golden, CO 80401). pp 131-166 of Silicon processing for photovoltaics I. Khattak, C.P.; Ravi, K.V. New York, NY; Elsevier Science Pub. Co. Inc. (1985).

Two ribbon growth methods for silicon date back to the mid 1960s. These are dendritic web growth, and Stepanov growth. Edge-defined film-fed growth (EFG), applied first to sapphire, and later to silicon was the first method directed to terrestrial photovoltaic (PV) applications. In the mid-1970s, many new growth methods specifically intended for low-cost PV use appeared. Edge-supported pulling (ESP) is a relatively new technique. Other recently introduced methods include melt spinning of various types and interface-controlled crystallization. A comprehensive review of the various sheet growth methods has been made. In edge-supported pulling, an elongated liquid silicon meniscus is formed between two thin parallel filaments that move through the liquid. The ends of the meniscus are pinned at the filaments. The base rises from the free liquid surface of the molten silicon. The meniscus top is originally attached to a silicon seed or other cross member, where sheet growth is initiated. As the filaments move through the liquid, the attached cross member moves away from the liquid surface, and a sheet continually solidifies between the filaments. The top of the meniscus is attached to the solid/liquid interface on the sheet.

34758 **Structural characterization of defects in solar silicon.** Ast, D.G.; Cunningham, B. (Materials Science and Engineering, Cornell Univ., Bard Hall, Ithaca, NY 14853). pp 247-306 of Silicon processing for photovoltaics I. Khattak, C.P.; Ravi, K.V. New York, NY; Elsevier Science Pub. Co. Inc. (1985).

This paper discusses techniques currently used to characterize defects in solar cell silicon. Since all of the techniques have been used to study defects in single crystal silicon, an extensive literature is available on the principles of their operation. Most of the paper is devoted to results obtained with optical and electron microscopy, since these are the most commonly used techniques to investigate microstructures. Characterization methods such as Rutherford backscattering (RBS) and deep level transient spectroscopy (DLTS) have limited spatial resolution and for this reason have not yet been extensively applied to the study of solar silicon.

34759 **Design considerations for photovoltaic driven vapor compression cycles.** Anana, D.K.; Le Chevalier, R. (Dept. of Mechanical Engineering, Univ. of Maryland, Bethesda, MD 20817). pp 371-384 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Since the vast majority of heat pumps, air conditioning and refrigeration equipment employs the vapor compression cycle (VCC) the use of renewable energy represents a significant opportunity. As discussed in this report, it is clear that the use of photovoltaics (PV) to drive the VCC has more potential than any other active solar cooling approach. This potential exists due to improvements in not only the PV cells but VCC machinery and control strategies. It is estimated that the combined improvements will result in reducing the PV cell requirements by as much as one half. A viable (cost and performance) PV driven VCC system requires work in the following areas: improvements in the EER of VCC from round 9 to above 12; use of DC brushless motors; elimination of battery storage; use of microprocessor control for the entire system. This paper discusses these issues and concludes that a harmonious working of all factors favorable to PV/VCC places it amongst the most viable technologies for solar applications.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 34737

34760 **(DOE/CE/11968—T1) SMUDPV2: Quarterly performance report No. 3 for the period October through December 1986.** Collier, D.E. (Sacramento Municipal Utility District, CA (USA)). Jan 1987. Contract FC03-83CE11968;FC03-82CE30701. 32p. NTIS, PC A03. File Number DE87006398.

SMUDPV2 is a nominal 1 MWac photovoltaic (PV) power plant located adjacent to the Rancho Seco generating station, 30 miles southeast of Sacramento, California. The design and construction of PV2 was a joint effort between the Sacramento Municipal Utility District (SMUD) and the United States Department of Energy (EOE). It is the second phase of a multiphase PV power plant project with a planned generating capacity of 100 MWac. SMUD's primary objective in this project is to install a PV power plant that will add economical energy generation capacity to their system. To this end, the data generated by the operation of PV2 will be used by SMUD to verify the value of PV to the rate payers of Sacramento, to assess the specific performance of the PV2 design, and to facilitate planning, design, and construction of future phases.

34761 **(DOE/CS/30088—T1) DOE Federal Photovoltaic Utilization Program: Final report.** (Tennessee Valley Authority, Chattanooga (USA)). 10 Apr 1987. Contract AI01-79CS30088. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007940.

Brief descriptions of several photovoltaic projects of the Tennessee Valley Authority are presented. (BCS)

34762 **(NP—7770096) On the non-linear static and dynamic calculation of gyroscopic shell and beam structures by the finite element method.** Mai, M.-M. (Stuttgart Univ. (Germany, F.R.). Fakultaet 9 - Luft- und Raumfahrttechnik). 20 Dec 1985. 149p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770096.

An economic process of calculation for the strength analysis of complex shell and beam structures, which rotate around a fixed axes and whose flexible additions (radio aerials, solar cell supports) suffer large deformation under quasi-static load applied in steps, is given in a matrix formula. Using canonic transformations of the generalized Hamilton equations, an asymmetrical dynamic matrix of double the dimensions is obtained, which contains the anti-symmetrical gyrostatic coefficient matrix. Analogous to the structure stiffness matrix, it is assembled from the CORIOLIS element matrices which are derived for beams and triangular plates.

34763 **(SAND—87-0097) 1987 photovoltaics annual systems symposium: Agenda and abstracts.** Chapman, R.N. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 68p. (CONF-870263—Summs.). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87006334.

From Photovoltaics annual systems symposium; Austin, TX, USA (18 Feb 1987).

The 1987 Photovoltaic Annual Systems Symposium (PASS'87) is being held at La Mansion Hotel, February 18, 19, and 20, 1987, in Austin, Texas. The meeting is sponsored by Sandia National Laboratories, the US Department of Energy, and the City of Austin Electric Utility Department. This document contains a summary of the findings from PASS'86, the agenda for PASS'87, and extended abstracts describing the PASS'87 presentations. The technical program is divided into five sessions: Department of Energy Program Directions, National and State Photovoltaic Activities, Subsystem Technology, Utility Interface Issues, and Stand-Alone Systems. A panel discussion scheduled for the afternoon of the 19th will focus on the utilities' perception of photovoltaics. A tour of

Austin's 300 kW Solar Photovoltaic Test Facility is available to those attending the symposium.

34764 **(SAND—87-0162C) The fundamentals of photovoltaic system electrical design.** Menicucci, D.; Key, T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 2p. (CONF-870711—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87005908.

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

This paper introduces the basic fundamentals of the design of electrical equipment for photovoltaic systems. (BCS)

34765 **(SAND—87-0168C) Photovoltaic systems for current and future applications.** Post, H.N.; Thomas, M.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870711—1). NTIS MF A01; 2; GPO Dep. File Number DE87006122.

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

This paper presents an examination of photovoltaic power system applications, including remote stand-alone, dispersed grid-connected and large generation centers. Photovoltaic system options for both current and future applications are described and costs for each of these options are developed. The results of this examination show that future applications will utilize the system technology available today and subsystem technology advances can be accommodated through minor system changes.

34766 **(SAND—87-1159C) Photovoltaic electrical system design practice: Issues and recommendations.** Key, T.; Menicucci, D. (Sandia National Labs., Albuquerque, NM (USA)). 7 May 1987. Contract AC04-76DP00789. 23p. (CONF-870528—13). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009294.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

As demand for photovoltaic (PV) power grows, so will the need to improve electrical subsystem safety and reliability. This paper documents some of the most significant electrical design problems and solutions experienced in fielded PV systems. The major focus is analysis of wiring, grounding and protection problems and employment of design lessons learned from their solution. Based on design experiences, general criteria are identified and electrical subsystem design practices are recommended for three classes of PV system applications.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 35234

34767 **(DOE/JPL—1060-92) Bearing development program for a 25-kWe solar-powered organic Rankine-cycle engine.** Nesmith, B. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Sep 1985. Contract AI04-80AL13137. 66p. (JPL-PUB—85-81p). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87005430.

This report summarizes the bearing development program for a 25-kWe power conversion subsystem (PCS) consisting of an organic Rankine-cycle engine, permanent magnet alternator (PMA) and rectifier to be used in a 100-kWe point-focusing distributed receiver solar power plant. The engine and alternator were hermetically sealed and used toluene as the working fluid. The turbine, alternator, and feed pump (TAP) were mounted on a single shaft operating at speeds up to 60,000 rev/min. Net thermal-to-electric efficiencies in the range of 21 to 23% were demonstrated at the maximum working fluid temperature of 400°C (750°F). A chronological summary of the bearing development program is presented. The primary causes of bearing wear problems were traced to a combination of rotordynamic instability and electrodynamic discharge across the bearing surfaces caused by recirculating currents from the PMA. These problems were resolved by implementing an externally supplied, flooded-bearing lubrication system and by electrically insulating all bearings from the TAP housing. This program resulted in the successful development of a stable, high-speed, toluene-lubricated five-pad tilting-pad journal bearing and Rayleigh step thrust bearing system capable of operating at all inclinations between horizontal and vertical.

34768 **(PNL—6128-Vol.2) Characterization of solar thermal concepts for electricity generation: Volume 2, Appendices.** Williams, T.A.; Dirks, J.A.; Brown, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010647.

Volume 1 of this report documented the analyses and evaluation of the concepts. This volume contains appendices which provided additional information on the approach used in the analysis, and further detail of the study results. Appendix A describes tradeoffs involved in the orientation of trough collector fields. The methodology used in the calculation of levelized energy costs is described in Appendix B. Additional detail on the annual energy output for each of the technologies is provided in Appendix C. Appendix D provides a discussion on the method and assumptions used in developing optical performance models for central receiver systems, and gives a detailed description of the results obtained. Plant cost data is shown in Appendix E, and a method for first-order sensitivity analyses using the data is described. The calculational approach used to estimate the manufacturing cost of distributed solar components is described in Appendix F.

1408 Ocean Energy Systems

REFER ALSO TO CITATION(S) 34538

34769 **(PB—87-173357/XAB) 40-MW(e) OTEC (Ocean Thermal Energy Conversion) plant at Kahe Point, Oahu, Hawaii: a case study of potential biological impacts. Technical memo.** Harrison, J.T. (National Marine Fisheries Service, Honolulu, HI (USA). Honolulu Lab.). Feb 1987. 111p. (NOAA-TM-NMFS-SWFC—68). NTIS, PC A06/MF A01.

Construction and operation of an Ocean Thermal Energy Conversion (OTEC) facility will affect marine, terrestrial, and atmospheric environments. The nature and degree of OTEC environmental impacts have been subjects of numerous studies and reports. The proposed 40-MWe OTEC plant at Kahe Point, Oahu, Hawaii has been the focus of much of the work. The first section provides a summary of pertinent design features of the proposed plant, including standard operating parameters. Next, salient elements of the biological oceanography in the region of the proposed development are summarized. The following sections discuss expected impacts of construction and operation of the plant, and finally, significant aspects of modeling studies conducted in support of the Kahe OTEC plant development are presented.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 34759

34770 **(IEA/SHC/NP—86) Status of national solar heating and cooling programmes in IEA countries, 1986.** Blum, S.; Mewshaw, J. (eds.). (International Planning Associates, Beltsville, MD (USA); International Energy Agency, 75 - Paris (France)). Feb 1987. Contract AC03-83SF11918. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010866.

This report is a compilation of papers on the solar heating and cooling programs of the member countries of the IEA Solar Heating and Cooling Program. The papers cover the current status of national programs, organization, funding, accomplishments and shifting emphasis as well as information on industry and commercialization developments in member countries. A summary of the major trends in national programs and market status of solar technology is also provided.

34771 **(IFU-B—23-85) Solar Energy Research Centre, Malta: development and construction of an absorption cooling plant driven by waste heat for refrigerating foodstuffs in developing countries. Final report.** Podesser, E. (Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung). Sep 1985. 22p. (In German). Forschungszentrum Graz (Austria). Inst. fuer Umweltforschung.

An absorption refrigerating machine for cooling a cold-storage room for foods, powered both by the heat concentrated in solar energy collectors and by waste heat from diesel engine exhaust. The heat taken up by the absorption system is returned to the environment by means of a cooling tower. Using diagrams of the principle involved and photographs of the assemblies, more detailed information is given of the system components such as the coldroom, heat source and the absorption refrigerating machinery as well as a diagrammatic representation of the hydraulic system of the plant (solar operation, operation with waste heat), the regulation controls of the refrigeration plant and of the measurements taken on this plant. The refrigeration performance achieved was over 10 kW. The evaporators were able to work in a range of -10°C to -3°C. The absorption refrigerator system had no trouble at all in maintaining the target temperature inside the cold storage room (+4°C to +7°C) built in the same way as containers. 4 figures.

34772 **(NMRDI—2-74-4628) Cost reduction of the Sun Challenger batch solar water heater: Final report.** Stickney, B.L. (New Mexico Univ., Albuquerque (USA). New Mexico Research and Development Inst.; Coyne Solar Mfg. Co., San Juan Pueblo, NM (USA)). May 1987. 35p. NTIS, PC A03/MF A01 - NMRDI-Univ. of New Mexico, 457 Washington, S.E., Albuquerque, NM 87108. File Number DE87900732.

A variety of materials and methods were investigated as a means to reduce the cost of the Sun Challenger Solar Collector. Three prototypes were constructed and tested using lower-cost methods. Test results are summarized, including heat gain, heat loss, and collection efficiency. Costs and benefits are also presented and summarized.

34773 **(NZERDC—121) The promotion of solar water heating systems: A review.** (Synergy Applied Research Ltd., Wellington (New Zealand); New Zealand Energy Research and Development Committee, Auckland). Dec 1985. 55p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87900751.

The objectives of this study were to assess the effectiveness of the promotion of domestic solar water heaters in New Zealand and, more specifically, to evaluate the effectiveness of the interest-free loan scheme for solar water heating systems. A data base concerning the development of the solar industry was established, and the interactions and relationships between the institutions and persons charged with formulating and executing policies were delineated. To determine people's perceptions of the scheme and technologies involved, and their consequential behavior, surveys were conducted of solar water heater users and non-users, and solar water heater manufacturers and installers. The report concludes with the formulation of a pilot market development scheme, designed to overcome perceived shortcomings in the existing domestic solar water heating promotional program.

34774 **(PB—87-167805/XAB) Solar-heated LP-gas (liquid petroleum-gas) vaporization. Technical report, 1985-1987.** Barnett, J.R. (Vapor Products Co., Odessa, TX (USA)). 16 Mar 1987. 10p. (VPC/S—87/01). NTIS, PC A02/MF A01.

The Collector' Solar-Heated Propane Vaporizer, Model SPV-067 is a concentrating, isotropic, solar collector utilizing a helical absorber and sand-storage medium. Phase-change material (Glaubers Salts) were tested and found to be approximately 300% inferior to the sand, with predominant consideration given to latent thermal capacity. These are isolated from the environment by a sealed acrylic dome. Direct and stored solar energy is absorbed via convection and applied to the contained LP-Gas Vapor to the extent of the available insolation. By isolating this vaporization process away from the liquid, consumption caused supercooling does not immediately effect the super-expandability of the vapor; this results in an observed annual fuel savings of 67% under an average ambient temperature of 60°F. with an average flow rate of 7.92 quarts per day of commercial propane fuel. The Collector being self-contained and weather resistant, requires no maintenance. Included are general directions, componant descriptions, and proposed Safety Standards for safety and installation.

34775 **(SERI/TP—254-3157) Polybutylene pipe freeze/thaw reliability testing.** Farrington, R.B. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1987. Contract AC02-83CH10093. 7p. (CONF-870711—4). NTIS MF A01; 2; GPO Dep. File Number DE87001166.

From Solar '87: 12th national passive solar conference; Portland, OR, USA (12 Jul 1987).

This paper discusses the ability of polybutylene pipe to withstand repeated freezing and thawing. The test apparatus, test procedure, list of chronological events, and results are discussed. Polybutylene piping has potential use in active solar heating systems and integral-collector-storage systems.

34776 **Overview: U.S. Department of Energy Solar Materials and Technology Development Program.** Neville, J.; Evans, D. (U.S. Dept. of Energy, 1333 Broadway, Oakland, CA 94612). pp 3305-3312 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—).

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

Using existing materials and technologies, the fundamental principles of passive solar design have been successfully applied to over 100,000 buildings in the U.S., primarily in the last decade. Even the best of these buildings, however, have only been able to provide an average of 40% of their heating, cooling and daylighting needs from the sun. The U.S. Department of Energy Solar Materials Reserach and Technology Development Program proposes to double this contribution in the next decade. Specifically, the Program is looking beyond traditional materials and methods to innovative new technologies, some of which have been developed in other industries, incorporating recently discovered techniques in optics, electrochemistry and particle physics. DOE is currently sponsoring a focused, multi-year program of high risk research designed to improve new and existing buildings' abilities to collect, transport and store energy.

34777 **The energy performance of buildings with distributed thermal storage.** Christensen, C.B.; Benson, D.K. (Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 815-822 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—). Contract AC02-83CH10093.

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

The cost of comfort control in a building can be reduced by moderating its temperature swings with distributed thermal energy storage components. Various storage concepts involving either heat or cool storage have been evaluated and potentially cost effective designs for passive solar and energy efficient buildings have been identified. The analyses make use of finite difference methods to solve thermal network building models at short time intervals over a full year's simulation. Each thermal storage component concept is modeled parametrically so that a series of annual building simulations provides a basis for selecting an optimum storage component design. The focus is on new solid-state, phase-change materials which, unlike previous phase-change materials, remain solid throughout the range of service temperatures.

34778 **Evaluating commercial solar water heating system designs.** Healey, H.M. (Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL 32920). pp 3-12 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

Many mistakes are being made in the design and installation of commercial solar water heating systems. These mistakes degrade the performance of the system, increase the payback period, short-

en the life and result in operational problems or failure of the systems. This paper discusses a procedure used by the Florida Solar Energy Center designed to eliminate these mistakes and evaluate solar system designs for Florida schools.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 34756, 34768

34779 **(AD-A—177981/8/XAB) Solar-cell-concentrator system. Master's thesis.** Sengil, N. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1986. 53p. (NPS—72-86-002). NTIS, PC A04/MF A01.

If solar cells are exposed to charged particle radiation, efficiency decreases. Also solar cell efficiency is increased by concentrated solar light. A solar-cell-concentrator system includes shielding against particle radiation and provides concentrated solar light, with increased efficiency. A solar-cell-concentrator system was constructed using a GaAs solar cell. Using a heat pipe, heat was transferred to a radiator. Cell operating temperature (77 C) and under concentrated solar light (Concentration Ratio = or approx. 130) solar-cell efficiency was measured. Observed efficiency was 18.18. + or - 0.18 (%). These results were used to calculate the performance of an array consisting of small concentrators. The performance of the concentrator array was compared with a conventional array, and demonstrated the higher efficiency advantages.

34780 **(BRE-IP—3/87) Solar dazzle reflected from sloping glazed facades.** Littlefair, P.J. (Building Research Establishment, Watford (UK)). Apr 1987. 4p. Publications Sales Office, Building Research Establishment, Garston, Watford WD2 7JR.

Glare or dazzle can occur when sunlight is reflected from a glazed facade. For vertical facades this problem usually occurs only when the sun is low in the sky; but some types of modern design incorporate sloping glazed facades which can, under certain circumstances, reflect unwanted high altitude sunlight into the eyes of motorists, pedestrians and people in nearby buildings. A new method which can be used at the design stage to calculate whether such solar dazzle will be reflected from a proposed building facade is discussed for the benefit of architects, consulting engineers, planning consultants and planners.

34781 **(DOE/AL/21557—T12) The Crosbyton Solar Power Project: Solar bowl subsystems tests and analyses.** O'Hair, E.A.; Simpson, T.L.; Green, B.; Krile, T.; Smith, M.; Jones, W.B.; Vann, W.P. (Texas Tech Univ., Lubbock (USA)). Apr 1987. Contract AC04-83AL21557. 127p. NTIS, PC A07. File Number DE87009659.

Extensive studies, tests and analyses have been done to decrease the costs and to increase the efficiency of solar bowls. Solar bowls are by design (stationary collector with tracking receiver) not as efficient as full tracking systems but are inherently simple to construct and operate. Construction, test and analyses of reflective surface supports, receivers, and mirror panels is presented. Three different types of reflective surface structural supports were investigated. Receiver designs to study creep and deformation were tested and different receiver surface configurations were exposed to laser light to determine solar flux absorption. Various types of reflector constructions and back surface supports were tested for vulnerability to hail and for back surface deterioration due to weathering and chemical reactions. The structural supports were costed at $'s/M^2, and measured for accuracy and rigidity. The receiver was measured for droop versus temperature and the receiver surfaces were measured for maximum absorptivity. Laminated mirror panels and 1' x 1' mirrors bonded on cement slabs were lab tested to determine the impact of hail on the mirror front surface and the effect on reflectivities due to weathering and the different bonding agents.

1420 Heat Storage

REFER ALSO TO CITATION(S) 34774, 34777

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

34782 **Assessment of geothermal related data bases.** Blackett, R.E. (Meridian Corp., Falls Church, VA). *Geo-Heat Center Quarterly Bulletin;* 9: No. 4, 8-11(Fal 1986).

Data bases that were developed for, or in connection with, DOE sponsored geothermal evaluation programs were reviewed with respect to their applicability and usefulness. Eight data bases were selected for the review based upon their potential widespread appeal and other factors. The data bases considered for this study were: (1) GEOTHERM - compiled by the US Geological Survey; (2) GRAD - Developed by Lawrence Berkeley Laboratory; (3) GPM - Developed by Mitre Corporation, currently under direction of Meridian Corporation; (4) OIT Site Data Bases - Compiled by the Oregon Institute of Technology, Geo-Heat Center; (5) UURI Open File Data - Compiled by the University of Utah Research Institute, Earth Science Laboratory; (6) UURI Sample Library - Compiled by the University of Utah Research Institute, Earth Science Laboratory; (7) Leasing and Permitting Data Base - Developed by WAPORA, Inc.; (8) LOGDEX Data Base - compiled by the University of Texas at Austin. These data bases were found to be useful for certain aspects regarding geothermal development and utilization.

1502 Geology And Hydrology Of Geothermal Systems

34783 (DOE/NV/10174—3, pp 1-158) **South White Lake prospect Cameron and Vermilion parishes, Louisiana.** Ross, S.P.; Pilger, R.H. Jr. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

The South White Lake area is approximately 50 miles from Lake Charles, Louisiana. The area covers about 175 miles and seven oil and gas fields are found there. The study was undertaken in an effort to evaluate geologic aspects of the South White Lake area as a potential geopressured-geothermal energy prospect. The report presented discusses the stratigraphy, structure, depositional environment, temperature and fluid pressure of the fields in the area.

34784 (DOE/NV/10174—3, pp 159-178) **Southeast Pecan Island-South Freshwater Bayou prospect.** Cavanagh, T.; Pilger, R.H. Jr. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

In the Annual Report for FY 1981, work on the Southeast Pecan Island Prospect (Plate 1) was described. As a result of the analysis of the prospect, four structure contour maps (plates 2-5), two interval isopach maps (plates 6 and 7), two net sandstone maps (plates 8 and 9), a salinity map (plate 10), and five cross sections (plates 11-15) were completed. From these maps and sections, it is apparent that the most desirable location of a geopressured-geothermal design test well would be in the center of T17S-R2E (S15-16). A significant sand development exists in this region in the interval of interest, below the Operculinoide's 9 sandstone marker. The sandstone exists within a larger fault block unit, and available seismic data do not indicate the existence of any additional faulting in the interval. Unlike many other prospects, this area appears lack abundant faulting which would break up the potential reservoir. In order to distinguish the location of the test well site proposed here (T17S-R2E), the site was termed South Freshwater prospect in the FY 81 report. If and when new design test well sites are selected, South Freshwater Bayou prospect should be seriously considered.

34785 (DOE/NV/10174—3, pp 179-193) **Revised interpretation of Lafourche Crossing geopressured-geothermal prospect from new seismic reflection data.** Beckman, D.; Pilger, R.H. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

The Department of Geology at Louisiana State University has been conducting a detailed study of the Lafourche Crossing geopressured-geothermal prospect under contract to the US Department of Energy. An earlier study by Franklin S. Snyder (1981) used all available well log information and limited seismic data to define the subsurface relationships present in this area. To further define these relationships, LSU contracted for three twenty-four fold common depth point reflection seismic lines in August of 1981 over the Lafourche Crossing prospect in Lafourche and Terrebonne parishes. These lines, labeled B, C, and D, are shown on the accompany shotpoint map. The three lines have been interpreted and the results incorporated with the earlier work of Snyder.

34786 (DOE/NV/10174—3, pp 194-214) **Kaplan prospect: net sand study.** Cassell, D.; Pilger, R.H. Jr. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

The Kaplan prospect, Vermilion and Acadia parishes, Louisiana, was identified as a desirable prospect for further study by the Petroleum Engineering Geopressured-Geothermal Energy Project, based on the analysis of a limited number of wells in the area. Originally, the prospect was selected for additional work under the Department of Geology contract (DE-AC08-79ET27019) and continued under the Energy Program Office - Louisiana Geological Survey contract (DE-AS05-78ET2702). The original graduate research assistant assigned to the prospect left before significant mapping had been completed. Later, an opportunity arose to at least complete a preliminary study of what has become one of the most critical parameters in evaluation of geopressured-geothermal resources - net sandstone thickness within the interval of interest.

34787 (DOE/NV/10174—3, pp 216-255) **Benthic foraminifera of Miocene geopressured strata of southern Louisian.** Gupta, B.K.; Lewis, L.T. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

Only a meager amount of micropaleontological information has been published on the geopressured and adjacent hydropressured units of the Miocene subsurface column of southern Louisiana. The goal of the present investigation was to utilize quantitative techniques of micropaleontology in order to assess patterns of benthic foraminiferal distribution in these rocks and their paleoenvironmental significance. This report contains a summary of the results and the initial interpretations.

34788 (DOE/NV/10174—3, pp 256-266) **Implications of fission track ages from the Kaplan geothermal-geopressure zone, Vermilion Parish, Louisiana.** Dokka, R.K. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

Apatite and zircon mineral separates were extracted from cores from near the bottom of two geopressured-geothermal wells in Vermilion Parish, southern Louisiana and dated by the fission track method. Samples were taken in the sandstone units of the Oligocene age Frio Formation. The purpose of the study was to determine if fission track clocks had been affected by long term heating within the zone. Downhole temperature measurements indicate that the samples are currently at 277°C (136°C) and 338° (169°C). Fission track clocks such as apatite and zircon lose their tracks when subjected to temperatures of 212°F (100°C) and 347°F (175°C), respectively, for geologically significant periods of time (one million years). Results show that apatite clocks were reset to 0 m.y. whereas zircon yielded ages of 62 and 68 m.y. (Cretaceous). If bottomhole temperature are reliable, then the data suggest the following: 1) Zircon ages are relict, reflecting times of cooling of the volcanic, plutonic, or metamorphic source. The Frio Formation in southern Louisiana was at least in part derived from a Cretaceous or older source. Such cooling ages are common in the Ouachitas, southern Appalachians, and Gulf Coast Plain. 2) Reset apatite and relict zircon ages suggest that temperatures within the geopressured zone have probably not been any higher than they are today - 347°F (175°C).

34789 (DOE/NV/10174—3, pp 267-276) **Residual temperature analysis: tracking subsurface fluid migration, with application to Lafourche Crossing prospect, Lafourche and Terrebonne parishes, Louisiana.** Pilger, R.H. Jr. 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

In order to test the separation of conductive and advective heat transfer mechanisms, seismic data from Lafourche Crossing project were used for predicting depth to the 200°F and 250°F isotherms over the entire area. The weak correspondence of the predicted and observed 200°F and 250° isotherm was supportive of the hypothesis that while the dominant heat transfer mechanism is conductive, advective flow is important in modifying the temperature field. Lateral heat advection results in increasing depth of temperature lows and decreasing depth of conductive highs.

34790 (DOE/NV/10174—3, pp 277-340) **Salinity and geochemistry of subsurface brines in South Louisiana and their potential for reaction with injected geothermal waste waters.** Hanor, J.S. (Louisiana State Univ., Baton Rouge). 25 Jun 1984. NTIS, PC A20/MF A01. File Number DE85006553.

In Technical support for geopressured-geothermal activities in Louisiana. Final geological report, 1 November 1981-31 October 1982.

Hydropressured, saline-water sands are being considered as possible sites for the disposal of geopressured-geothermal waste waters in South Louisiana. Probable injection horizons would most likely contain native brines of 120-140 g/l TDS. These brines show wide ranges in concentration of dissolved Ca, Sr, Ba, Fe, SO_4, and HCO_3, even within a restricted range of salinities. The probability is high that mineral precipitation will occur if untreated geopressured wastes are mixed with these waters. Clay migration and additional plugging of the injection well is possible if the injected wastes are significantly less saline than the native fluids. Costs of site-specific geochemical evaluation and chemical pretreatment are thus factors which must be considered in the economic evaluation of deep well disposal of geopressured wastes in South Louisiana.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 34796, 35845, 35888

34791 **(LA—10957-OBES) Core lithology, Valles caldera No. 1, New Mexico.** Gardner, J.N.; Goff, F.; Goff, S.; Maassen, L.; Mathews, K.; Wachs, D.; Wilson, D. (Los Alamos National Lab., NM (USA)). Apr 1987. Contract W-7405-ENG-36. 273p. NTIS, PC A12/MF A01; 1; GPO Dep. File Number DE87010831.

Vallas caldera No. 1 (VC-1) is the first Continental Scientific Drilling Program research core hole in the Vallas caldera and the first continuously cored hole in the region. The hole penetrated 298 m of moat volcanics and caldera-fill ignimbrites, 35 m of volcaniclastic breccia, and 523 m of Paleozoic carbonates, sandstones, and shales with over 95% core recovery. The primary research objectives included coring through the youngest rhyolite flow within the caldera; obtaining structural and stratigraphic information near the intersection of the ring-fracture zone and the pre-caldera Jemez fault zone; and penetrating a high-temperature hydrothermal outflow plume near its source. This report presents a compilation of lithologic and geophysical logs and photographs of core that were collected while drilling VC-1. It is intended to be a reference tool

for researchers interested in caldera processes and associated geologic phenomena.

34792 **(LBL—22487) Perspective and trends: Future of geothermal exploration technology.** Goldstein, N.E. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 31p. (CONF-861147—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010282.

From Symposium on the future of geothermal energy; San Diego, CA, USA (17 Nov 1986).

Some examples are given of where current research in seismic and electromagnetic imaging may eventually lead to practical technologies for exploration. These are technologies that will provide a relatively high resolution, 2-D and 3-D parameterized picture of the earth to depths of two to three km. Parameters discussed include P- and S-wave velocities and electrical resistivity.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 34793

1509 Geothermal Engineering

34793 **(BNL—39626) Advanced materials and biochemical processes for geothermal applications.** Kukacka, L.E.; van Rooyen, D.; Premuzic, E.T. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 14p. (CONF-8704124—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010447.

From 5. annual Department of Energy geothermal program review; Alexandria, VA, USA (14 Apr 1987).

Two Geothermal Technology Division (GTD)-sponsored programs: (1) Geothermal Materials Development, and (2) Advanced Biochemical Processes for Geothermal Brines, are described. In the former, work in the following tasks is in progress: (1) high temperature elastomeric materials for dynamic sealing applications, (2) advanced high temperature (300°C) lightweight (1.1 g/cc) well cementing materials, (3) thermally conductive composites for heat exchanger tubing, (4) corrosion rates for metals in brine-contaminated binary plant working fluids, and (5) elastomeric liners for well casing. Methods for the utilization and/or the low cost environmentally acceptable disposal of toxic geothermal residues are being developed in the second program. This work is performed in two tasks. In one, microorganisms that can interact with toxic metals found in geothermal residues to convert them into soluble species for subsequent reinjection back into the reservoir or to concentrate them for removal by conventional processes are being identified. In the second task, process conditions are being defined for the encapsulation of untreated or partially biochemically treated residues in Portland cement-based formulations and the subsequent utilization of the waste fractions in building materials. Both processing methods yield materials which appear to meet disposal criteria for non-toxic solid waste, and their technical and economic feasibilities have been established.

34794 **(LA-UR—87-1256) Recent US Hot Dry Rock reservoir testing and hydrothermal modeling.** Kelkar, S.; Malzahn, M.V. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 15p. (CONF-8704111—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008996.

From Forced flow through fractured rock masses; Garcy, France (13 Apr 1987).

Testing is in progress at the site of the US Hot Dry Rock (HDR) reservoir at Fenton Hill, New Mexico. Several hydraulic stimulation tests have been conducted in the reservoir since January 1985. The reservoir being tested is at a nominal depth of 3650 m (11,975 ft). In a successful flow-through test conducted in 1986, 37,000 m^3 (9.8 million gal) of cold water was injected at controlled rates up to 0.0265 m^3/s (420 gpm). During this test, 23,000 m^3 (6.1 million gal) of hot water at temperatures up to 190°C was recovered, corresponding to 9 MW thermal power. The injection of large amounts of cold water at high pressures into the naturally fractured, granitic formation leads to complex flow fields, strongly influenced by coupled fluid flow, heat transfer and stress effects. In order to predict reservoir performance over time spans of interest (~20 years), it is necessary to evaluate the influence of these coupled processes. This need has led to efforts to upgrade an existing finite element, heat and mass transfer code to include coupled stress effects while retaining the computational efficiency needed for simulations of long-term reservoir performance. This paper describes field test results, a conceptual model of the reservoir, and code development efforts.

34795 **(NZERDC-P—112) Geothermal corrosion.** Pound, B.G.; Sharp, R.M.; Wright, G.A. (Auckland Univ. (New Zealand); New Zealand Energy Research and Development Committee, Auckland). Dec 1986. 136p. NTIS (US Sales Only), PC A07/MF A01. File Number DE87900739.

The report is comprised of five papers on various aspects of geothermal corrosion reactions and test methods. Separate abstracts have been prepared for the individual papers. (ACR)

34796 **(PNL-SA—14847) Geothermal chemistry in-line instrumentation.** Shannon, D.W.; Robertus, R.J.; Kindle, C.H.; Sullivan, R.G.; Raney, P.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 17p. (CONF-8704110—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011140.

From 5. geothermal program review; Washington, DC, USA (14 Apr 1987).

During Fiscal Years 1986 and 1987, Pacific Northwest Laboratory (PNL) achieved several major milestones: (1) a Site Access Agreement with San Diego Gas and Electric Company was signed and since renewed for Fiscal Year 1987; (2) the PNL field laboratory was moved from East Mesa to the Heber Binary Plant; (3) a subcontract was let to a commercial supplier of pH probes to build advanced transistor-based pH sensors; (4) a field test determined response of the transistor-based pH probes to Heber brines; (5) a filter test was performed to look at scaling tendencies of the Heber plant brine if it were cooled below 150°F; and (6) two prototype particle counters based on ultrasonic sound and a laser beam scattering were tested in the laboratory and subjected to one field test.

1520 Geothermal Data And Theory

34797 **(DOE/ID—10170) Simulation of irreversible rock compaction effects on geopressured reservoir response: Topical report.** Riney, T.D. (S-Cubed, La Jolla, CA (USA)). Dec 1986. Contract FC07-85NV10412. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011041.

A series of calculations are presented which quantitatively demonstrate the effects of nonlinear stress-deformation properties on the behavior of geopressured reservoirs. The range of stress-deformation parameters considered is based on information available from laboratory rock mechanics tests performed at the University of Texas at Austin and at Terra Tek, Inc. on cores recovered from geopressured wells. The effects of irreversible formation rock compaction, associated permeability reduction, and repetitive load/unload cycling are considered. The formation rock and geopressured brine properties are incorporated into an existing reservoir simulator using a bilinear model for the irreversible compaction process. Pressure drawdown and buildup testing of a well producing from the geopressured formation is simulated for a suite of calculations covering the range of formation parameters. The results are presented and discussed in terms of the inference (e.g., permeability and reservoir volume) that would be drawn from the simulated test data by an analyst using conventional methods.

16 Tidal Power Plants

REFER ALSO TO CITATION(S) 34538

17 WIND ENERGY

34798 **(DOE/BP/25593—2) Regional Wind Energy Assessment Program: Progress report, October 1984-September 1985: Appendix.** Wade, J.E.; Baker, R.W.; Redmond, K.; Wittrup, R.J.; Buckley, J. (Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.). Jul 1986. Contract AC79-81BP25593. 159p. (BPA—86-22). NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010348.

This report summarizes the wind statistics gathered at 65 sites in the BPA wind network over the period June 1984 through May 1985. The analysis of these data completes the BPA Regional Wind Energy Assessment Program (WIND REAP) that has been ongoing since 1981. A climatological analysis of 12 selected sites distributed throughout the entire BPA service area indicated that fall winds were stronger than normal, spring winds were about normal and winter winds were significantly weaker than normal. There was considerable variation throughout the region in the wind's difference from normal during the summer months. Temperature, pressure nd precipitation data were also analyzed for several National Weather Service sites. The trends in precipitation and to a lesser extent temperature followed those of wind speeds. In the fall, stronger than normal winds were related to greater than normal precipitation. During the winter, colder and drier conditions were associated with below normal winds.

1701 Availability (climatology)

34799 **(NZERDC—136) Small scale wind power guide for New Zealand, Australia and the South Pacific.** Edwards, P.J. (Otago Univ., Dunedin (New Zealand). Dept. of Physics; New Zealand Energy Research and Development Committee, Auckland). Nov 1986. 90p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87900758.

This report reviews the present and potential use of wind energy in small-scale applications with particular reference to New Zealand and Australia. The report is written in the form of a systems level guide to potential users and designers of wind power systems who have little or no prior knowledge in this field. The main emphasis is on remote area electric power supply applications, as these are continuing to attract interest despite the lower oil prices of the mid 1980s. Specialist and traditional applications such as electric fencing and water pumping are well documented elsehwere. The guide provides a basis for a systematic approach to the systems level design and component selection and the technical and financial evaluation of wind power supply systems. Examples of typical power and energy demands, New Zealand site characteristics and systems are given in the text, culminating in a number of Design Case Studies. A set of ten Design Guide Sheets are used to assist and illustrate the design process. These are reproduced in the text and in the Appendices.

1706 Wind Energy Engineering

34800 **(DOE/CE/15278—T3) [Design and demonstrate a low head-hi volume pump compatible with the Av-Yo, Inc. proprietary variable stroke control windmill system]: 3rd quarterly technical report, [December 1986 to March 1987].** Young, B.F.; Avery, D.E. (AV-YO, Inc., Haleiwa, HI (USA)). 1987. Contract FG01-86CE15278. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87007164.

The technical and commercialization accomplishments of a windmill pumping system are presented. (BCS)

34801 **(DOE/CH/10252—1) Wake effects in a Fayette 95-IIS wind turbine array: [Final report].** Simon, R.L.; Matson, D.F.; Fuchs, J.M. (Fayette Mfg. Corp., Tracy, CA (USA)). 22 Jan 1987. Contract FC02-86CH10252. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87007595.

Commercial wind farms generally consist of quasi-orthogonal arrays of wind turbines. Developers like to locate as many turbines as possible on a specific property; however, if they are packed too closely, rotor wakes impinge on downwind turbines and reduce their energy production. This report therefore represents the first publicly-funded study to examine array wake effects in an operating wind farm with direct measurements.

34802 **(ORNL/Sub—81-7242/1) Methodology for control and operation of wind arrays in utility systems: Final report.** Younkins, T.D. (General Electric Co., Schenectady, NY (USA). Electric Utility Systems Engineering Dept.). Apr 1987. Contract AC05-84OR21400. 290p. NTIS, PC A13. File Number DE87008546.

A methodology is developed that can be used by utilities to determine whether control of Wind Turbine (WT) arrays is needed on an Automatic Generation Control time scale - seconds to minutes. Control Strategies are developed that will, if needed, compensate for WT power variation by controlling either selected conventional units in a Feed Forward mode or the WT arrays in a Closed Loop mode. Both modes utilize short term (10 minute) prediction of maximum available (open loop) WT array power. Limited simulations of three utility systems are presented that confirm the usefulness of the methodology and the Control Strategies. Simulation results indicated that WT arrays will be noticeable at ~5% penetration and control should be considered at ~10 to 20% penetration. Recommendations are made for future work, including the need for characterizing actual 10 minute changes in open loop WT array power.

34803 **(PB—87-163150/XAB) Analysis and simulation of a wind turbine with variable speed.** Steinbuch, M.; Meiring, F. (Keuring van Electrotechnische Materialen N.V., Arnhem (Netherlands)). 1986. 13p. NTIS, PC PC E03/MF E01.

Pub. in Kema Scientific and Technical Reports, Vol. 4, No. 7 71-78(1986).

An appropriate controller must be designed if the desired performance of a wind turbine with a synchronous generator and AC/DC/AC conversion is to be achieved. The dynamic performance of such a system was therefore investigated. The wind turbine was simulated at several operating points, using a detailed nonlinear model. It is shown that the sensitivity of the wind turbine to changes of the pitch angle depends largely on the operating conditions and thus enhances the need for robust or adaptive control. The interaction between the mechanical and electrical parts was also investigated. The characteristic dynamics are quantified with an eigenvalue analysis which also shows that the system has both very fast and very slow dynamics. The results obtained indicate the need for more-systematic control design procedures dealing with all relevant dynamics.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 35005

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 34510, 34513, 34513, 34513, 34835

34804 **(AD-A—178553/4/XAB) Diesel-electric cogenerating power plant assessment for remote-site applications. Final report, August-December 1985.** Chuang, H.N. (Dayton Univ., OH (USA). Research Inst.). Oct 1986. 21p. NTIS, PC A02/MF A01.

This program was directed toward assessing the life-cycle cost (LCC) of state-of-the-art diesel-electric cogenerating power plants at Air Force remote sites. This report assesses the LCC's of present and future diesel cogenerating plants for use at the Distant Early Warning Line (DEWLine) radar sites in Alaska and Canada. The LCC consists of the fuel cost, acquisition cost, and the operation and maintenance cost. These costs were evaluated in constant 1985 dollars with no escalation or depreciation over a 20-year power plant life. The electrical size of the individual plants on the

DEWLine ranged from 60 to 500 kilowatts (kW). The main emphasis of this study was on the 200-kW-size power plants. (Author)

34805 (CONF-8403254—) **Cogeneration in practice. Proceedings.** (Zentrum fuer Angepasste Technologie und Sozialoekologie, Langenbruck (Switzerland)). 1984. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

These conference documents focus on cogeneration power plants, whose various possibilities were studied under the aspect of energy saving. The following problems of cogeneration power plants are discussed: planning, installation, various modes of operation, environmental problems, and the use of gas motors. (HAG).

34806 (CONF-8403254—, pp 1-13) **Planning and installation of cogeneration power stations.** Pauli, H. 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

The paper contains some basic ideas of planning and building of cogeneration power stations, including the various parts of the plant (driving engines, generator etc.) as well as the achievable degree of efficiency. The use of biogas is discussed as well as various sites and possible areas of application under the aspect of economic efficiency. Finally the costs of investment and operation are considered and the problems of obtaining building permits is briefly discussed. (HAG).

34807 (CONF-8403254—, pp 1-15) **Experiences with the operation of cogeneration power stations.** Luedin, W. (Elektra Birseck, Muenchenstein, Switzerland). 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

Operational experiences with cogeneration power stations are described and evaluated. Power production and waste heat utilization in West German stations are analysed first. Some general observations on cogeneration in small, decentralised plants are followed by a discussion of experiences made in operating them. Dimensioning of cogeneration plants, the heat demand and the need to run such small plants outside the public utility system are further subjects of this paper. The cost of energy produced in these plants are analysed and the issue of compensation payments for the users of higher-prices energy from cogeneration plants are discussed. Problems of heat-supply programmes and of finding an adequate collective of users are described. (HAG).

34808 (CONF-8403254—, pp 1-19) **State-of-the-art and developments.** Hein, K. (Arbeitsgemeinschaft fuer Sparsamen und Umweltfreundlichen Energieverbrauch e.V., ASUE, Frankfurt am Main, Germany, F.R.). 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

This paper looks into developments of decentralised cogeneration. The part on motors deals with various combinations such as power-compressed air-heat or power-heat-cold. Maintenance, cost of maintenance, emissions, emission-reducing methods with a view to efficiency are further issues of the paper. (HAG).

34809 (CONF-8403254—, pp 1-31) **Saving energy with gas motors.** Goliob, K. (Jenbacher Werke A.G., Jenbach, Austria). 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

The focus of this paper is on the use of gas motors in cogeneration plants in order to save energy. Typical examples of gas-motor equipped plants which have been operating for some time, are discussed. Three basic schemes for waste heat utilization in a gas-motor equipped plant are given and described. (HAG).

34810 (CONF-8403254—, pp 1-18) **Biogas fuelled modular cogeneration plants.** Eichenberger, H. (Saurer, A.A.G., Arbon, Switzerland). 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

The Total-Energy-Modul TOTEM, a serially produced cogeneration plant of the modulator type with a nominal output of 15 kW and a heat output of 38 kW is described technologywise and plant structurewise. TOTEM is a mature product of the FIAT-Research which has been tested since 1976 and is already prodcued in series. The multiple and varied examples of application of the plant here and abroad shows that TOTEM is a proved and reliable system that really helps both the consumer and the economy in general to save energy. (orig./HAG).

34811 (CONF-8403254—, pp 1-10) **Energy saving with gas motors in the ARA Falkenstein.** Baumgartner, R. 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

The paper deals with possibilities of saving energy in a sewage treatment plant, the best of which is to use the produced biogas in a cogeneration plant. All important aspects of projecting functioning and construction are dealt with, experiences with operating the plant are also reported on. (HAG).

34812 (DOE/MC/21389—2345) **Combustion and fuel bound contaminant control with a staged cyclone coal combustor for gas turbines: Final report, September 26, 1984 to December 31, 1986.** (Coal Tech Corp., Merion, PA (USA)). 31 Dec 1986. Contract AC21-84MC21389. 238p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87010423.

The present project was an analytical and experimental study of contaminant control in a cyclone coal combustor operating under output temperatures applicable to gas turbines. An evaluation of recent, coal-fired, gas turbine-combined cycle systems studies was made to select suitable combustor operating conditions. This was used to prepare test plans for experiments designed to evaluate operational parameters affecting SO/sub x/ and NO/sub x/ emission control from a 5 to 7 million Btu/h, staged, cyclone, coal combustor operating under a wide range of combustion temperature outlet conditions and stoichiometric ratios in the combustor. An extensive series of parameteric experiments were performed, using a finely pulverized West Virginia, Bituminous, low sulfur (0.8%S) coal, an Illinois Herrin Seam, medium sulfur (1.6%S) coal, and an Illinois No. 6, high sulfur (3%S) coal.

34813 (EPRI-EL—4911) **Development of telemetry for high-speed rotor instrumentation and monitoring: Final report.** Mallick, G.T.; Nenno, P.N.; Parker, J.H.; Eckels, P.W. (Westinghouse Electric Corp., Orlando, FL (USA). Steam Turbine Generator Div.; Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 121p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920451.

A modern data acquisition and telemetry system for rotating systems was developed as a part of a program, jointly funded by EPRI and Westinghouse, to develop a 300 MVA superconducting generator. While the overall program was terminated before completion, the telemetry development task was essentially complete at termination. It had been planned that the data acquisition and telemetry system was to be used in large scale models and the final 300 MVA rotor testing for transmitting sensor data from the rotating frame. An important part of this development was the qualification of a number of cryogenic sensors that were to be used in conjunction with the telemetry system for measuring temperature, strain and liquid helium level. The telemetry system that was developed handled the data transmission by digital frequency shift keying with a carrier of 200 kHz. The analog sensor signals were amplified and filtered "on-board" before being multiplexed and converted to a digital signal. All of this was under the control of a single chip microcomputer (Intel 8748) in the rotating frame. The overall sensor, data acquisition and telemetry system were operated

and tested under rotation for a period of over one hundred hours. Overall, the system has proven itself to be reliable and effective. The present report covers all aspects of this development in detail, including the circuit and software design and performance. 27 refs., 58 figs.

34814 **(PB—87-179321/XAB) Environmental controls for waste-to-energy plants. Report for February-March 1987.** Huffman, G.L. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Apr 1987. 27p. (EPA—600/D-87/112). NTIS, PC A03/MF A01.

The paper provides a literature review of selected, published literature relative to the performance of certain pollution-control technologies that have been applied to Waste-to-Energy (WTE) plants. It discusses various environmental standards adopted by three European countries and three U.S. states for WTE plants. The paper describes the pollutant emissions and residues exiting plants of this type, and delineates the performance of two Canadian air-pollution-control technology pilot plants applied to the flue gases of such plants.

2002 Environmental Control Technology

REFER ALSO TO CITATION(S) 34462, 34736, 35435, 35587, 35588, 35647

34815 **Aqueous absorbents and membranes for a new flue gas SO/sub 2/ and NO/sub x/ removal process using electrodialysis for regeneration.** Walker, R.J.; Drummond, C.J. New York, NY; American Institute of Chemical Engineers (1986). 46p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

A proposed process is described for removing SO/sub 2/ and NO/sub x/ simultaneously from power-plant flue gas by passing the gas through a wet scrubber, followed by electrodialysis to remove sulfite and sulfate ions from the scrubbing liquor and thermal stripping to remove NO/sub x/. The sulfite and sulfate ions are used to produce sulfuric acid, while the stripped NO/sub x/ is reburned in the boiler. Preliminary tests of a bench-scale electrodialysis stack are described. Absorption and stripping tests of various aqueous absorbents in a one-meter column are also described; the tests were conducted to screen the absorbents for NO/sub x/ and SO/sub 2/ removal ability. Emphasis was on metal-chelate solutions. The best absorbent tested removed 98% of the NO and 99% of the SO/sub 2/ from simulated flue gas containing 5.9% oxygen.

2003 Power Transmission And Distribution

REFER ALSO TO CITATION(S) 35013, 35075

34816 **(AD-A—178945/2/XAB) Transient protection of electronic circuits. Final report, June 1983-July 1984.** Standler, R.B. (Air Force Weapons Lab., Kirtland AFB, NM (USA)). Feb 1987. 222p. (AFWL-TR—85-34). NTIS, PC A10/MF A01.

Electromagnetic pulses from nuclear weapons, lightning, and electrostatic discharge are three examples of electrical overstress. Such overstress can cause failure, permanent degradation, or temporary malfunction (upset) of electronic devices and systems. This problem and general solutions are briefly reviewed. Nonlinear components and circuits for protection from electrical overstress are discussed in detail, emphasizing spark gaps, metal oxide varistors, and avalanche diodes. However, other components, such as semiconductor diodes, thyristors, resistors, inductors, and optoisolators are also discussed. Applications of these nonlinear components are discussed in the context of signal lines, AC power lines, and DC power supplies. The final chapter discusses specific upset protection circuits.

34817 **(DOE/ET/29372—6) Distribution system simulator.** Bahrami, K.A.; Kirkham, H.; Rahman, S. (Jet Propulsion Lab., Pasadena, CA (USA)). 15 Aug 1986. Contract AI05-79ET29372. 44p. (JPL-PUB—86-41). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87005418.

In a series of tests, power line carrier propagation was observed to be anomalous under certain circumstances. To investigate the cause, a distribution system similar was constructed. The simulator was a physical simulator that accurately represented the distribution system from below power frequency to above 50 kHz. Effects such as phase-to-phase coupling and skin effect were modeled. Construction details of the simulator and experimental results from its use are given in this report.

34818 **Pulse shaping with transmission lines.** Wilcox, R.B. (to Dept. of Energy, Washington, DC). US Patent 4,667,161. 19 May 1987. Filed date 15 Aug 1985. vp.

This patent describes an apparatus for forming a voltage pulse of a desired shape, comprising: means for generating an input pulse; a reflecting transmission line connected to the means for generating an input pulse, the reflecting transmission line having an impedance which varies with length to produce a reflected pulse having a desired pulse shape; and pulse removal means connected to the reflecting transmission line for transmitting a shaped reflected pulse to a load. The means for generating an input pulse and pulse removal means comprise: a first and second switch in a normally nonconducting state; a first transmission line connected between the first and second switches; the first transmission line being connected to the reflecting transmission line through the first switch; and the first transmission line being connected to a load through the second switch.

34819 **Control aspects of the Tacoma superconducting magnetic energy storage project.** Hauer, J.F.; Boenig, H.J. (Bonneville Power Administration, Portland, OR 97208). *IEEE Transactions on Power Systems;* **PWRS-2**: No. 2, 443-450(May 1987).

On February 16, 1983, a 10 MW/30 MJ superconducting magnetic energy storage unit was energized at the Bonneville Power Administration (BPA) substation in Tacoma, Washington. The unit was retired a year later, after extensive tests directed toward its experimental use as a small-signal stabilizer for the Pacific AC Intertie. This paper addresses the control aspects of the project. These include the response characteristics of the unit, a-priori modeling of power system response, tradeoffs in control-law design, measured power system dynamics, and projection of unit effectiveness as a stabilizer.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 34831, 34990

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 34850, 34866, 34879, 34884, 34885, 34886, 34888, 34889, 34890, 34891, 34892, 34893, 34894, 34895, 34896, 34897, 34898, 34899, 34900, 34902, 34903, 34904, 34905, 34906, 34908, 34910, 34911, 34912, 34913, 34914, 34915, 34916, 34917, 34920, 34921, 34922, 34923, 34924, 34925, 34926, 34928, 34929, 34930, 34931, 34932, 34933, 34935, 34937, 34938, 34939, 34940, 34941, 34942, 34943, 34944, 34945, 34946, 34947, 34948, 34949, 34950, 34951, 34952, 34953, 34954, 34955, 34956, 34957, 34963, 34964, 34965

34820 **(CONF-8610135—48) Reliability of leak detection systems in LWRs.** Kupperman, D.S. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004832.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In this paper, NRC guidelines for leak detection will be reviewed, current practices described, potential safety-related problems discussed, and potential improvements in leak detection technology (with emphasis on acoustic methods) evaluated.

34821 Prediction of environmental and strain-rate effects on the stress corrosion cracking of austenitic stainless steels. Maiya, P.S. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL 60439). *Journal of Pressure Vessel Technology;* **109**: No. 1, 116-123(Feb 1987).

The stress corrosion cracking (SCC) susceptibility of austenitic stainless steels in high-temperature water is controlled by environmental variables (e.g., dissolved oxygen, corrosion potential, impurities), microstructure (e.g., degree of sensitization), and strain rate. A phenomenological model based on the slip-dissolution mechanism and elastic-plastic fracture mechanics is presented to quantitatively describe the effects of both environment-related parameters and strain rate on SCC in constant extension rate tests. The model predictions are in good agreement with the results of tests performed on Types 304, 316, and 316NG stainless steel at different strain rates in a wide variety of environments relevant to boiling-water reactors.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 34820, 34846, 34848, 34849, 34858, 34864, 34865, 34867, 34872, 34873, 34879, 34880, 34881, 34883, 34887, 34889, 34890, 34891, 34892, 34893, 34894, 34895, 34896, 34897, 34898, 34900, 34901, 34902, 34903, 34904, 34905, 34906, 34907, 34908, 34910, 34911, 34912, 34913, 34914, 34915, 34917, 34918, 34919, 34920, 34921, 34922, 34924, 34925, 34926, 34927, 34928, 34929, 34930, 34931, 34932, 34933, 34934, 34935, 34936, 34937, 34938, 34939, 34940, 34941, 34942, 34943, 34944, 34945, 34946, 34947, 34948, 34949, 34950, 34951, 34952, 34953, 34954, 34955, 34956, 34964, 34965

34822 (DOE/BP—820) WNP-1 and -3 study: 1987 resource strategy. (Bonneville Power Administration, Portland, OR (USA)). May 1987. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009990.

Since the draft WNP-1 and -3 Study, Bonneville has decided to only commit funds for resources that are needed for committed loads. Currently, no investor-owned utility (IOU) has made a contractual commitment to purchase from Bonneville beyond 1993. For this reason, Bonneville now includes no IOU load growth in assessing the need for WNP-1 and -3 in its "base case" analysis. Bonneville's study conclusion is that, on balance, preserving both WNP-1 and -3 is still the prudent choice for now. However, as soon as significant progress has been made in resolving uncertainties, Bonneville will revisit the prudence of continued preservation. The findings indicate no clear choice between preservation and termination on a net present value basis, a choice somewhat in favor of preservation from an economic risk management standpoint, and a clear choice in favor of preservation on the basis of contract risks and refinancing uncertainty. Considerations of near-term Bonneville revenue requirements and WNP-1 conversion uncertainty also are somewhat favorable to continued preservation. There are no other decision factors which strongly favor preservation or termination.

34823 (EPRI-NP—5192) Microstructural effects on microdeformation and primary-side stress corrosion cracking of Alloy 600 tubing: Final report. Bruemmer, S.M.; Charlot, L.A.; Henager, C.H. Jr. (Pacific Northwest Lab., Richland, WA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. Contract AC06-76RL01830. 74p. NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. File Number DE87010293.

Microdeformation characteristics in Alloy 600 tubing have been examined after various tensile deformations. Microstructure developed during processing was found to control subsequent microdeformation behavior. Grain boundary carbides were the most effective source of dislocations, activating at lower macro-strains and continuing to operate at higher macro-strains than other sources. Ledges within grain boundaries, twin boundaries and matrix carbides also acted as dislocation sources. Most dislocation activity at low strains was confined to planar arrays. A conceptual model is presented to account for the effects of interfacial and matrix microstructure on microdeformation and primary-side SCC of Alloy 600 tubing. Microstructure is linked to IGSCC resistance through its influence on microdeformation behavior and the resultant crack-tip stress state. Dislocation source activity at grain interfaces is proposed to be a critical aspect controlling IGSCC susceptibility. Effective sources such as grain boundary carbides promote crack blunting, decrease the crack-tip stress state and increase resistance to cracking.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 34909, 34962

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 34934, 35508

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 34596, 34610, 34868, 34909, 36177, 36224

34824 (FRA-TM—155) Neutronic studies of the long life core concept: Part 1, Design and performance of 1000 MWe uranium oxide fueled low power density LMR cores. Orechwa, Y. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010266.

The parametric behavior of some key neutronic performance parameters for low power density LMR cores fueled with uranium oxide is investigated. The results are compared to reference homogeneous and heterogeneous cores with normal fuel management and Pu fueling. It can be concluded that with respect to minimizing the initial fissile mass and thereby economizing on the inventory costs and carrying charges, the superior neutron economy of the LMR fuel cycle is best exploited through normal fuel management with Pu recycling. In the once-through mode the LMR fuel cycle has disadvantages due to a higher fissile inventory and is not competitive with the LWR fuel cycle.

34825 (FRA-TM—156) Neutronic studies of the long life core concept: Part 2, The effect of fuel type and design constraints. Orechwa, Y. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010267.

The design requirements for achieving long life core designs which will have the favorable property of a near zero burnup swing are studied. It is shown that long life cores with this property and based on metal fuel can be designed relatively far more easily than cores based on oxide fuel. This is especially true when U-235 is used as the fissile material. 20 figs., 5 tabs.

34826 (FRA-TM—157) Neutronic studies of the long life core concept: Part 3, Preliminary metal fueled core optimization for the Large Scale Prototype Breeder. Orechwa, Y. (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010268.

A design envelope for LSPB size metal fueled cores is developed with respect to minimizing the fissile inventory and achieving a zero or positive reactivity swing over a burn cycle. Consideration is given to assembly design, choice of core configuration, fuel management scheme, and the attendant neutronic performance. It is therefore recommended that further optimization of LSPB sized metal LMRs center on cores with a heterogeneous configuration of fuel assemblies, fuel pin diameters of ~0.30 in., a core height of 3 ft, and fuel management based on annual batch refueling.

34827 (HEDL-SA—3635-VT) Advanced fabrication technology. Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 8 Nov 1986. Contract AC06-76FF02170. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010217.

The Fuel Cycle Plant is a multipurpose nuclear facility located on the Hanford Nuclear Reservation in eastern Washington state. The facility is part of the Hanford Engineering Development

Laboratory which is operated by Westinghouse Hanford Company for the Department of Energy. The Fuel Cycle Plant is currently being prepared to support the Liquid Metal Reactors Program with fuel fabrication services for the Fast Flux Test Facility and other LMR programs. This report describes the technical innovations to be utilized in the operation of this plant.

34828 **(HEDL-SA—3689) Corrosion and fission products in primary systems of liquid metal cooled reactors in the USA.** Brehm, W.F.; Colburn, R.P.; Maffei, H.P.; Stinson, W.P.; Bunch, W.L.; Bechtold, R.A.; Olson, W.H. (Hanford Engineering Development Lab., Richland, WA (USA); Argonne National Lab., Idaho Falls, ID (USA)). 1987. Contract AC06-76FF02170. 16p. (CONF-8705101—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009516.

From IAEA/IWGFR specialists' meeting on fission and corrosion products in primary systems of LMFBR's; Karlsruhe, F.R. Germany (5 May 1987).

This paper presents a summary of the work in the USA to support the measurement and control of radionuclides in primary systems of liquid metal cooled reactors. The efforts to characterize and control the ingress of radioactive corrosion and fission products, fuel particles, and radioactivity in gas systems have been quite successful in the USA.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

34829 **(CONF-870102—2) The role of integral experiments and nuclear cross section evaluations in space nuclear reactor design.** Moses, D.L.; McKnight, R.D. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01. File Number DE87007004.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

The importance of the nuclear and neutronic properties of candidate space reactor materials to the design process has been acknowledged as has been the use of benchmark reactor physics experiments to verify and qualify analytical tools used in design, safety, and performance evaluation. Since June 1966, the Cross Section Evaluation Working Group (CSEWG) has acted as an interagency forum for the assessment and evaluation of nuclear reaction data used in the nuclear design process. CSEWG data testing has involved the specification and calculation of benchmark experiments which are used widely for commercial reactor design and safety analysis. These benchmark experiments preceded the issuance ofIthe industry standards for acceptance, but the benchmarks exceed the minimum acceptance criteria for such data. Thus, a starting place has been provided in assuring the accuracy and uncertainty of nuclear data important to space reactor applications. (FI)

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 34837, 34956

34830 **(EPRI-NP—4977) Simulator qualification plan: Interim report.** Donovan, M.D.; Pellechi, M.S.; Schmidt, P.M.; Utterback, R.G. (General Physics Corp., Atlanta, GA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 216p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920220.

Qualification of a nuclear power plant training simulator involves both validation and verification. Response of the simulator in duplicating various training scenarios are validated against plant data or, if unavailable, engineering code output data. Verification involves confirming the accuracy of the simulator. The EPRI plan for simulator qualification described in this report details the procedures to validate the performance of the simulator and to verify its compliance with applicable regulatory requirements. An estimate of the resources to conduct this plan is included as are the necessary forms to document performance.

34831 **(NUREG—0540-Vol.9-No.3) Title list of documents made publicly available: March 1-31, 1987.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). May 1987. 466p. NTIS, PC A20/MF A01 - GPO. File Number TI87900775.

This document is a monthly publication containing descriptions of information received and generated by the US NRC. This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author Index, Corporate Author Index, Report Number Index, and Cross Reference to Principal Documents Index.

34832 **(NUREG—0750-Vol.24-No.1) Nuclear Regulatory Commission issuances.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Jul 1986. 203p. NTIS, PC A10/MF A01 - GPO. File Number TI87900893.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

34833 **(NUREG—0936-Vol.5-No.2) NRC [Nuclear Regulatory Commission] regulatory agenda: Quarterly report, April-June 1986.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records). Dec 1986. 173p. NTIS, PC A08/MF A01 - GPO. File Number TI87900416.

The Regulatory Agenda is a quarterly compilation of all rules on which the NRC has proposed, or is considering action as well as those on which it has recently completed action, and all petitions for rulemaking which have been received and are pending disposition by the Commission.

34834 **(NUREG—1021-Rev.4) Operator licensing examiner standards.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Licensee Performance and Quality Evaluation). May 1987. 200p. NTIS, PC A09/MF A01 - GPO. File Number TI87900735.

The Operator Licensing Examiner Standards provide policy and guidance to NRC examiners and establish the procedures and practices for examining and licensing of applicants for NRC operator licenses pursuant to Part 55 of Title 10 of the Code of Federal Regulations (10 CFR 55). They are intended to assist NRC examiners and facility licensees to understand the examination process better and to provide for equitable and consistent administration of examinations to all applicants by NRC examiners. These standards are not a substitute for the operator licensing regulations and are subject to revision or other internal operator examination licensing policy changes.

2108 Economics

REFER ALSO TO CITATION(S) 34822

34835 **(DOE/NE—0078) Nuclear Energy Cost Data Base: A reference data base for nuclear and coal-fired power-plant power generation cost analysis.** Delene, J.G.; Bowers, H.I. (USDOE Assistant Secretary for Nuclear Energy, Washington, DC. Plans and Evaluation Div.). Dec 1986. 134p. NTIS, PC A07/MF A01. File Number DE87004452.

A reference data base and standard methodology are needed for performing comparative nuclear and fossil power generation cost analyses for the Department of Energy, Office of Nuclear Energy. This report contains such a methodology together with reference assumptions and data to be used with the methodology. It is intended to provide basic guidelines or a starting point for analyses and to serve as a focal point in establishing parameters and methods to be used in economic comparisons of nuclear systems with alternatives. The data base is applicable for economic com-

parisons of new base load light-water reactors on either the current once-through cycle or self-generated recycle, high- and low-sulfur coal-fired plants, and oil- and natural gas-fired electric generating plants coming on line around the turn of the century. In additions to light-water reactors and fossil fuel-fired plants, preliminary cost information is also presented on liquid metal reactor plants. This report includes a data base containing proposed technical and economic assumptions to be used in analyses, discussions of recommended methodology to be used in calculating power generation costs, and a sample calculation for illustrative benchmark purposes.

34836 (NUREG/CR—4012-Vol.2) Replacement energy costs for nuclear electricity-generating units in the United States, 1987-1991. VanKuiken, J.C.; Guziel, K.A.; Buehring, W.A.; Hamilton, B.P. (Argonne National Lab., IL (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Jan 1987. Contract W-31109-ENG-38. 251p. (ANL/AA—30-Vol.2). NTIS, PC A12/MF A01 - GPO. File Number TI87005449.

Seasonal replacement energy costs are estimated for potential short-term shutdowns of 116 nuclear electricity-generating units. These estimates were developed to help the US Nuclear Regulatory Commission (NRC) establish regulatory policies, particularly those requiring safety modifications that might necessitate temporary reactor shutdowns. Cost estimates were derived from probabilistic production-cost simulations of pooled utility-system operations. Factors affecting replacement energy costs, such as random unit failures, maintenance and refueling requirements, and load variations, are treated in the analysis. Seasonal costs are presented for the five-year period beginning with 1987 and ending with 1991. This information updates cost estimates that were developed previously for the NRC and published in NRC Report NUREG/CR-4012, Vol. 1. The updates were undertaken to extend the time frame of cost estimates and to account for recent changes in utility system conditions, such as fluctuations in fuel prices, changes in construction and retirement schedules, and adjustments to system demand projections.

22 NUCLEAR REACTOR TECHNOLOGY

REFER ALSO TO CITATION(S) 36040

2202 Components And Accessories

REFER ALSO TO CITATION(S) 34871, 34872, 35134, 35377, 36190

34837 (BMU—1986-113) Data compilation on nuclear codes and guidelines for materials, calculation and testing of safety requirements for licensing and surveillance procedures (construction materials and components for nuclear power plants). Final report. Schick, M.; Herter, K.H. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). Sep 1986. 56p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-01436.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Within the scope of the BMI-project SR 163 work has been carried out as to how far the nuclear codes represent the current status in science and technology and whether they contain appropriate regulations to avoid severe events. The present status of the codes was confirmed to be sufficient with respect to the relevant aspects. Independent of this statement a series of verifications and complementations has proved to be necessary without, however, requiring prompt action so that the related work can be performed step by step. The further work is focussed on the principal aim to keep the nuclear codes up to date by - as far as necessary - improving and developing them in such a manner, that the codes remaining in accordance with the actual situation.

34838 (BNL—39695) Nuclear propulsion systems for orbit transfer based on the particle bed reactor. Powell, J.R.; Ludewig, H.; Horn, F.L.; Araj, K.; Benenati, R.; Lazareth, O.; Slovik, G.; Solon, M.; Tappe, W.; Belisle, J. (Brookhaven National Lab., Upton, NY (USA); Grumman Aerospace Corp., Bethpage, NY (USA); Babcock and Wilcox Co., Lynchburg, VA (USA); Garrett Engine Co., Phoenix, AZ (USA)). 1987. Contract AC02-76CH00016. 30p. (CONF-870102—23). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010060.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

The technology of nuclear direct propulsion orbit transfer systems based on the Particle Bed Reactor (PBR) is described. A 200 megawatt illustrative design is presented for LEO to GEO and other high ΔV missions. The PBR-NOTV can be used in a one-way mode with the shuttle or an expendable launch vehicle, e.g., the Titan 34D7, or as a two-way reusable space tug. In the one-way mode, payload capacity is almost three times greater than that of chemical OTV's. PBR technology status is described and development needs outlined.

34839 (CEA-CONF—8725) Behavior of reactor materials under irradiation. Quere, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Oct 1986. 10p. (CONF-8609273—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752094.

From 1. Franco-Argentin symposium on materials science; Mar del Plata, Argentina (29 Sep 1986).

This paper describes some of the most important phenomena under irradiation concerning fuel elements (UO/sub 2/ and UO/sub 2/+PuO/sub 2/) and structural materials (steels and zirconium base alloys).

34840 (EPRI-NP—5000) Sealing of nuclear plant electrical equipment: Final report. Gleason, J.F. (Wyle Labs., Huntsville, AL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 67p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920223.

The nuclear power industry has many applications where electrical equipment is required to operate in environments which contain high relative humidity, steam and water or chemical sprays. Equipment is susceptible to these environments by moisture entering through inherent design provisions such as O-rings and through the electrical interface. The objective of this research is to review electrical interface sealing techniques and to recommend methods for providing effective electrical interface sealing. The most common methods of sealing are the use of electrical fittings containing sealants, add-on assemblies and hardware changeout. The experience gained in several years of testing electrical interface seals on such devices as limit switches, solenoid valves and transmitters is presented to provide information on seal effectiveness and preferred application. The effectiveness of various sealing methods is discussed, each of which is dependent upon the device being sealed, parameters to which it has been tested and other factors such as orientations and mountings. Additionally, proper installation is critical and installation guidelines are provided.

34841 (EPRI-NP—5014) Fracture testing of ductile steels: Final report. McCabe, D.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center; Electric Power Research Inst., Palo Alto, CA (USA)). Jan 1987. 89p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920227.

This program's objective was to develop a verification of the R-Curve methodology on structural steels. R-Curve is a record of material toughness development during the stable crack growth process. To predict crack instability, R-Curves are coupled with crack drive descriptions which are available from elastic-plastic calibration solutions. R-Curve must have well-defined properties, and the postulate that R-Curve is independent of certain geometry variations was under evaluation here. In this work, the R-Curve fracture toughness was determined on typical nuclear grade stainless steel piping materials and their associated weld joint materials.

It was demonstrated that with controlled constraint, R-Curve behavior of ductile materials is independent of specimen or component size. R-Curve behavior of ductile materials was also shown to be independent of loading mode.

34842 **(HEDL-SA—3642) Dynamic magnification of piping systems with inelastic behavior.** Weiner, E.O. (Hanford Engineering Development Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76FF02170. 7p. (CONF-870636—10). NTIS, PC A02. File Number DE87009970.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

Plastic transient analyses of four piping systems were carried out to provide estimates of strains occurring at various levels of seismic shaking. Pipe diameters range from one to six inches. Loads include deadweight as well as harmonic or seismic base excitation. Strain ranges up to 14% were incurred. In no case was there an indication of a sudden excess deformation with increasing load level as expected in a statically load-controlled environment. Magnifications and phase shifts are suggestive of significant frequency shifts and effective damping from plastic deformation. Quasistatic plastic analyses using modal load patterns provide estimates of frequency shift, damping and system ductility as functions of strain range. Comparisons are provided between transient and quasistatic analyses as well as test results.

34843 **Validation of inelastic analysis by full-scale component testing.** Griffin, D.S.; Dhalla, A.K.; Woodward, W.S. (Westinghouse Electric Corp., Advanced Energy Systems Div., Madison, PA 15663). *Journal of Pressure Vessel Technology;* **109**: No. 1, 42-49(Feb 1987).

This paper compares theoretical and experimental results for full-scale, prototypical components tested at elevated-temperatures to provide validation for inelastic analysis methods, material models, and design limits. Results are discussed for piping elbow plastic and creep buckling, creep ratcheting, and creep relaxation; nozzle creep ratcheting and weld cracking; and thermal striping fatigue. Comparisons between theory and test confirm the adequacy of components to meet design requirements, but identify specific areas where life prediction methods could be made more precise.

34844 **The Los Alamos liquid hydrogen neutron-moderator system.** Robinson, H.; Russell, G.J.; Williamson, K.D.; Edeskuty, F.J. New York, NY; American Institute of Chemical Engineers (1986). 13p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

A liquid-hydrogen neutron-moderator system was designed, tested, and successfully operated in the Los Alamos Neutron Scattering Center (LANSCE). The major system components include a 450-500 W helium refrigerator, a helium/hydrogen heat exchanger, a liquid hydrogen centrifugal pump, and a target chamber. The design and testing of the system are discussed and experimental results presented. To date the target has been subjected to beam currents as high as 35.5 μa (25W). Suggestions for future improvements are given.

34845 **Vibration identification of nuclear reactor components by statistical analysis of neutron noise.** Sankoorikal, J.T. Ames, IA; Iowa State Univ. (1986). 151p. University Microfilms Order No. 87-03,757.

Thesis (Ph. D).

The possibility of identifying vibrating components, in a nuclear reactor core, through the use of statistical techniques was investigated. Mechanical vibrations produce neutron noise that appears as fluctuations in detector signals. Theory pertaining to the production of neutron noise is discussed. Vibrations are characterized by location and vibration trajectory parameters. Maximum-likelihood and confidence-region techniques were developed to estimate these parameters. Computer experiments were carried out using simulated detector signals for a simplified reactor model. The sensitivity of the techniques was investigated by parametrically studying the effects of noise level in the detector signal and the presence of external noise or bias in the model. The use of the Fisher information matrix, as a tool, to estimate the optimum number and pattern of detectors required in the identification process, was demonstrated. An experiment was performed utilizing the Iowa State University UTR-10 reactor to demonstrate the validity of the statistical techniques developed. A vibrating absorber, moving in one dimension, was operated in the fuel region and measurements were taken with four detectors. Detector responses, in terms of auto-power spectral densities, were calculated using a modified version of the computer code, Exterminator-2.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 34859, 34861

2204 Control Systems

REFER ALSO TO CITATION(S) 34830, 34834, 34878, 34945

34846 **(BMU—1986-120) PWR vibration monitoring - international state-of-the-art.** Sunder, R.; Wach, D. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 110p. (In German). (GRS-A—1155). NTIS, PC E11; Available from NTIS as TIB/B87-01426.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

Based on guidelines of Reactor Safety Commission and Nuclear Safety Standard Commission, vibration monitoring of PWR primary circuits is practised in Federal Republic of Germany for early failure detection. The report describes corresponding activities of foreign countries in a comparative manner. As far as it can be deduced from available literature, hardware of installed vibration monitoring systems, practical experience with monitoring procedure, state of the art of pattern interpretation and future developments will be discussed. International experience with failure predictions gathered up to now in addition with an survey of observed vibrational problems in PWR's are summarized in tabular form, giving an idea about the range of application of vibration monitoring.

34847 **(DOE/NE/37959—1) Signal validation in nuclear power plants: Annual progress report for the period September 30, 1986-September 29, 1987.** Kerlin, T.W.; Upadhyaya, B.R.; Gloeckler, O.; Frei, Z.; Qualls, L.; Gaudio, P.J. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering; Combustion Engineering, Inc., Windsor, CT (USA)). May 1987. Contract AC02-86NE37959. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010234.

In large sysstems, such as nuclear power plants, chemical plants and others, signals from various instrumentation systems are channeled to control systems, protection systems, and plant monitoring systems. Validation of these signals is necessary to minimize plant downtime, to increase the reliability of operator decisions and to aid in scheduling plant maintenance. The research program at the University of Tennessee and its subcontractor, Combustion Engineering, Inc.,, is directed towards developing a comprehensive signal validation system for implementation in current and future power plants (advanced reactors). The signal validation architecture consists of parallel signal processing modules, each of which implements a diverse validation scheme. The various modules are being evaluated using PWR plant simulation data from combustion Engineering, Inc., and operational data from Northeast Utilities Millstone III plant. Currently, all the modules are being developed and tested using the IBM-AT computer.

34848 **(EPRI-NP—4413M-Vol.1) PWR Power Shape Monitoring System (PWR-PSMS): Volume 1, Technical description and evaluation: Final report.** Peng, C.M.; Ipakchi, A.; Khadem, M. (Systems Control, Inc., Palo Alto, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 108p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920447.

The Power Shape Monitoring System (PSMS) is a computer system for on-line monitoring and prediction of reactor cores. The heart of the PSMS consists of a nodal code (NODEP-2/THERM-P) that computes the 3-D core power distribution. This code is coupled to a simplified nodal version of the COBRA-IIIC/MIT-2 thermal-hydraulic model to determine the DNBR. Activation of the calculations and review of the results is through user-friendly interactive software that can be tailored to the requirements and capabilities of the different categories of users through table-driven menus. The PSMS can be adapted to PWRs developed by any of the three PWR vendors in the US; however, from the technical point of view, the most difficult problem is associated with monitoring plants without fixed in-core neutron detectors. It has been demonstrated that adaptation of the nodal code to partially fit the available in-core detector readings, followed by a statistical characterization of the remaining errors, results in better accuracy and improved sensitivity for anomaly detection compared to an approach that is entirely dependent upon the detector readings. The approach has been carefully benchmarked to Movable In-Core Detector (MID) readings from two plants and also to fixed in-core readings from one plant. The computed power distribution at steady state, high power conditions normally has an uncertainty of about 3% for the nodal power and 2% for the bundle power.

34849 (EPRI-NP—4413M-Vol.2) PWR Power Shape Monitoring System (PWR-PSMS): Volume 2, Benchmark report: Final report. Peng, C.M.; Ipakchi, A.; Khadem, M.; Chen, H.T. (Systems Control, Inc., Palo Alto, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 271p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920448.

The Power Shape Monitoring System (PSMS) is a computer system for on-line monitoring and prediction of reactor cores. It can be used for real-time monitoring of the core power distribution and the margin to the limiting value of the Departure from Nucleate Boiling Ratio (DNBR), load-following core performance analysis, and predictive analysis. The heart of the PSMS consists of a nodal code (NODEP-2/THERM-P) that computes the 3-D core power distribution. This code is coupled to a simplified nodal version of the COBRA-IIIC/MIT-2 thermal-hydraulic model to determine the DNBR. Activation of the calculations and review of the results is through user-friendly interactive software that can be tailored to the requirements and capabilities of the different categories of users through table-driven menus. The PSMS can be adapted to PWRs developed by any of the three PWR vendors in the US; however, from the technical point of view, the most difficult problem is associated with monitoring plants without fixed in-core neutron detectors. It has been demonstrated that adaptation of the nodal code to partially fit the available in-core detector readings, followed by a statistical characterization of the remaining errors, results in better accuracy and improved sensitivity for anomaly detection compared to an approach that is entirely dependent upon the detector readings. The approach has been carefully benchmarked to Movable In-Core Detector (MID) readings from two plants and also Fixed In-Core (FIC) readings from one plant. The computed power distribution at steady state, high power conditions normally has an uncertainty of about 3% for the nodal power and 2% for the bundle power.

34850 (EPRI-NP—5211M) Validation of critical BWR [boiling water reactor] signals: Final report. Deutsch, O.; Sweed, G.; Garner, G.; Ornedo, R.; Hopps, J. (Draper (Charles Stark) Lab., Inc., Cambridge, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 148p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920434.

Signal validation, in the context of this research project, is the process of combining information from multiple plant sensors to produce highly reliable information about plant conditions. Sensor information is acquired in digital form, at regular sample intervals of typically several seconds, and the signal validation operation is performed concurrently. Hence, the output of signal validation is available in real-time to support monitoring and control functions. High information reliability is achieved by the use of redundant sources of information and by the inherent detection, identification, and isolation of faulty signals.

34851 (HEDL-SA—3300) A control system verifier using automated reasoning software. Smith, D.E.; Seeman, S.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1985. Contract AC06-76FF02170. 7p. (CONF-850903—31). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010415.

From International topical meeting on computer applications for nuclear power plant operation and control; Pasco, WA, USA (8 Sep 1985).

An on-line, automated reasoning software system for verifying the actions of other software or human control systems has been developed. It was demonstrated by verifying the actions of an automated procedure generation system. The verifier uses an interactive theorem prover as its inference engine with the rules included as logical axioms. Operation of the verifier is generally transparent except when the verifier disagrees with the actions of the monitored software. Testing with an automated procedure generation system demonstrates the successful application of automated reasoning software for verification of logical actions in a diverse, redundant manner. A higher degree of confidence may be placed in the verified actions of the combined system.

34852 (HEDL-SA—3573-VT) Procedure generation and verification. Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 15 Jul 1986. Contract AC06-76FF02170. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010221.

The Department of Energy has used Artificial Intelligence of "AI" concepts to develop two powerful new computer-based techniques to enhance safety in nuclear applications. The Procedure Generation System, and the Procedure Verification System, can be adapted to other commercial applications, such as a manufacturing plant. The Procedure Generation System can create a procedure to deal with the off-normal condition. The operator can then take correct actions on the system in minimal time. The Verification System evaluates the logic of the Procedure Generator's conclusions. This evaluation uses logic techniques totally independent of the Procedure Generator. The rapid, accurate generation and verification of corrective procedures can greatly reduce the human error, possible in a complex (stressful/high stress) situation.

34853 (RISO-M—2616) Simulation of operators' response in emergencies. Rasmussen, J. (Risoe National Lab., Roskilde (Denmark)). Sep 1986. 100p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87752178.

For the simulation of the accidential course of events in industrial process plants, a model is needed of operators' response to the cues presented by the system. A model is proposed, based on the simplifications which can be made when restricting attention to the operator functions having significants for a probabilistic risk analysis, and to anly skill and rule based performance, i.e., to responses in the early phase of an accident. The model is based on Brunswik's lens model, a model of the normal task repertoire, and on a taxonomy of human errors. To bring the model in perspective, a review of the state of the art of cognitive models of human behaviour is included.

34854 (UNI-SA—194) An approach to a complex data base design. Brooks, D.L. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 27 Oct 1986. Contract AC06-76RL01857. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004425.

This brief report gives general information on the controlling programs for a nuclear plant training simulator. Several routines are mentioned that allow updating and use of the model's data base. The report describes how the routines access the three-level data base. (JDH)

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 34828, 34958, 34960, 34961, 35436, 35844

34855 (EGG-M—29486) Transporting TMI-2 [Three Mile Island Unit 2] core debris to INEL: Public safety and public response. Schmitt, R.C.; Reno, H.W.; Young, W.R.; Hamric, J.P. (EG and G Idaho, Inc., Idaho Falls (USA); USDOE, Washington, DC). 1987. Contract AC07-76ID01570. 7p. (CONF-870306—48). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009396.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

This paper describes the approach taken by the US Department of Energy (DOE) to ensure that public safety is maintained during transport of core debris from the Unit-2 reactor at the Three Mile Island Nuclear Power Station near Harrisburg, PA, to the Idaho National Engineering Laboratory near Idaho Falls, ID. It provides up-to-date information about public response to the transport action and discusses DOE's position on several institutional issues. The authors advise that planners of future transport operations be prepared for a multitude of comments from all levels of federal, state, and local governments, special interest groups, and private citizens. They also advise planners to keep meticulous records concerning all informational transactions.

34856 (ISH—11) Investigations into the emission of iron-55 and nickel-63 from off-gas of nuclear power plants in the Federal Republic of Germany in the years 1979-1981. Gesewsky, P.; Vogl, K.; Winkelmann, I. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1982. 50p. (In German). NTIS, PC E07; Available from NTIS as TIB/B86-10119.

Described here are radiochemical methods for the separation of the elements Iron and Nickel in filter samples exposed to gaseous effluents from nuclear power plants. The decomposition and preparation of the filter samples is discussed for the measurement of Iron-55 and Nickel-63 by liquid scintillation spectrometry. This report contains measurements of Iron-55 and Nickel-63 emissions in the gaseous effluents taken between 1979 to 1981. Both the measured activity concentrations obtained from quarterly samples and the quarterly and yearly emissions of these radionuclides are given.

34857 (ISH—75) Measurements of airborne radioactive emissions from nuclear power plants and their quality control in the Federal Republic of Germany. Winkelmann, I.; Fields, D.E. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jul 1985. 38p. NTIS, PC E07; Available from NTIS as TIB/B86-10114.

Procedures have been established which govern monitoring and the detailed assessment by plant operators of gaseous radioactive releases from nuclear power plants. Of primary interest is the Safety Standard KTA 1503. In presenting and describing the measuring techniques, the detection of specific radionuclides in gaseous effluents is of major importance. The description of measuring techniques is exemplified by results from emission measurements and the resulting radiation exposure to the public for the year 1983. A supervisory program is also discussed here. A detailed description of the routine measurement program, the comparative measurements during the starting phase of a nuclear power plant and the quality control by round-robin-tests is given.

34858 (UCID—20963-Pt.1) Environmental radiological studies conducted during 1986 in the vicinity of the Rancho Seco Nuclear Power Generating Station. Noshkin, V.E.; Wong, K.M.; Eagle, R.J.; Brunk, J.L.; Jokela, T.A. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010945.

This report summarizes the information compiled in 1986 for our assessment of the environmental impact of radionuclides discharged with aqueous releases from the Rancho Seco Nuclear Power Generating Plant. In October 1984, a liquid-effluent control program was initiated that significantly reduced the quantities of radionuclides discharged with liquid waste from the plant. However, results from our sampling program in 1986 indicate that previously discharged radionuclides persist in the downstream environment and are found in many aquatic dietary components although at concentrations much lower than those measured in 1984 and 1985. The greatly reduced activities in the dietary components from the aquatic environment attest to the effectiveness of the liquid-effluent control program. Concentrations in the flesh of fish from the creeks have decreased over time and with distance from the plant outfall. The mean concentration of ^{137}Cs in fish collected from Laguna Creek at locations more than 7.5 km from Rancho Seco is now comparable to the concentration determined in fresh-water fish randomly selected from Chicago, Illinois, markets. By August 1986, the mean concentration of ^{137}Cs in the flesh of bluegill had fallen to 7% of the concentration measured in fish from comparable locations in 1984 and was 30% of the mean concentration measured in these fish during August 1985. Stable potassium in the water plays a major role in the accumulation of ^{137}Cs by fish. Concentrations of ^{137}Cs in the surface sections of creek sediments also declined between the end of 1984 and 1986 with an effective half-life of approximately 2 y. Surface soils collected around a perimeter 11 km from Rancho Seco and from ranchlands closer to the plant showed only concentrations of ^{137}Cs originating from global fallout. Soils previously irrigated with Clay Creek water retain levels of both ^{134}Cs and ^{137}Cs.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 34845, 34927

34859 (HEDL-SA—3546) Remote weighing of irradiated fuel pins at FFTF [Fast Flux Test Facility]. Anglesey, M.O.; Romrell, D.M. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1986. Contract AC06-76FF02170. 12p. (CONF-861102—44). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009975.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

The Fuel Pin Weighing System used at the Fast Flux Test Facility, Richland, Washington, was previously described as it was intended for use in the Fuels and Materials Examination Facility. The system has since been modified, tested, and installed in the Interim Examination and Maintenance Cell to help identify breached fuel pins. These modifications include hardware design changes and the addition of a computer for system control and for collecting and processing the pin weight data. This pin weighing system has proven to be accurate and reliable for the IEM cell application.

34860 (HEDL-SA—3696) Audits and surveillance: A functional quality surveillance system. Smart, R.J.; Duda, J.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76FF02170. 15p. (CONF-870499—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009969.

From 7. western regional energy division conference; Richland, WA, USA (19 Apr 1987).

The implementation of a quality surveillance program can be painless and productive. The system described in this report has been in use at the Fast Flux Test Facility (FFTF) for more than a year and effectively fills the void between audits and inspections. Recognized benefits of this system include: minimum administrative overhead; excellent management overview; ease of implementing trending efforts; audit supplement; fully computerization; lower cost than traditional methods; early problem detection, adaptability to other projects and facilities.

34861 (NUREG/CR—4866) An assessment of hydrogen generation for the PBF severe fuel damage scoping and 1-1 tests. Cronenberg, A.W.; Miller, R.W.; Osetek, D.J. (EG and G Idaho, Inc., Idaho Falls (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Accident Evaluation). Apr 1987. Contract AC07-76ID01570. 93p. (EGG—2499). NTIS, PC A05/MF A01 - GPO. File Number TI87010249.

An evaluation of zircaloy oxidation and hydrogen generation data is presented for the first two Severe Fuel Damage (SFG) tests, conducted in the Power Burst Facility at the Idaho National Engi-

neering Laboratory. This work is in support of an internationally sponsored severe accident research program, initiated by the US Nuclear Regulatory Commission to advance the understanding and methodology for predicting light water reactor core degradation, hydrogen generation, and fission product behavior during severe accidents. The principal objective of this report is an assessment of in-vessel hydrogen generation issues using data provided by the SFD Scoping Test (SFD-ST) and SFD 1-1 test. The principal issues in question are the influence of zircaloy melting on oxidation behavior and fuel bundle reconfiguration effects which may alter steam flow and hydrogen generation characteristics. 41 refs., 42 figs., 11 tabs.

34862 (ORNL/TM—10433) Bulk shielding facility: Quarterly report, January, February, and March 1987. Hamrick, T.P.; Muggridge, F.E. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010149.

The BSR operated at an average power level of 1318 kW for 21.1% of the time during January, February, and March. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The PCA is shut down for shim-safety rod magnets and associated electronic components upgrading. (FI)

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 36177

2208 Propulsion Reactors

34863 (BNL—39696) Ultra-high temperature direct propulsion. Araj, K.J.; Slovik, G.; Powell, J.R.; Ludewig, H. (Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC02-76CH00016. 13p. (CONF-870102—24). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010066.

From 4. symposium on space nuclear power systems; Albuquerque, NM, USA (12 Jan 1987).

Potential advantages of ultra-high exhaust temperature (3000 K - 4000 K) direct propulsion nuclear rockets are explored. Modifications to the Particle Bed Reactor (PBR) to achieve these temperatures are described. Benefits of ultra-high temperature propulsion are discussed for two missions - orbit transfer ($\Delta V = 5546$ m/s) and interplanetary exploration ($\Delta V = 20000$ m/s). For such missions ultra-high temperatures appear to be worth the additional complexity. Thrust levels are reduced substantially for a given power level, due to the higher enthalpy caused by partial disassociation of the hydrogen propellant. Though technically challenging, it appears potentially feasible to achieve such ultra high temperatures using the PBR.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 34850, 34852, 34993, 35844, 36223

34864 (BMU—1986-114) Possibilities of hydrogen removal phase III/3: Concluding evaluation of the potential of deliberate ignition as hydrogen mitigation measure for hypothetical severe accidents in pressurized water reactors. Langer, G.; Baukal, W.; Scheibel, H.G. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.)). Sep 1986. 94p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-01437.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The report deals with the method of "Deliberate Ignition", which was selected as the hydrogen mitigation measure with comparable fewest disadvantages. The method still includes some relevant in terms of safety-open questions, which were dealt with in the light of most recent research results (especially from the USA). The safety-relevance of the questions has been reduced further, but there was no final consens achieved among the experts. For a final release of this method some more investigations, especially experimental investigations, seem to be necessary. These were defined in detail. They include mainly the problem of the mode of hydrogen combustion in a multi-compartment-geometry (the interaction between combustion and distribution, effects of multiple ignition). When the results of those investigations are submitted, a new evaluation of the Deliberate Ignition may be performed, e.g. a consideration of the possible safety benefits compared to the status-quo is possible. Independent of this, there has to be the discussion whether counter-measures for the control of hypothetical severe accidents are reasonable and necessary. The total project SR 212/SR 365 is already now available as a basis for a later re-assessment of measures to control the hydrogen-problem during hypothetical severe accidents.

34865 (BMU—1986-118) Study on the possibilities of after-heat removal from a PWR nuclear power station after a time-limited failure of the alternating current supply. Final report. Bracht, K.; Herbold, G.; Kersting, E.; Korbach, W. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.)). Sep 1986. 116p. (In German). (GRS-A—1221). NTIS, PC E11; Available from NTIS as TIB/B87-01435.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

As a part of investigations on accidents beyond the design basis measures for minimizing the damage by a station black-out-transient in a German 1300 MW PWR plant (KWU-Konvoi-conception) have been analysed. Calculations with the GRS-Computer Code DRUFAN-02 show that by activating a feed and bleed-operating mode for the secondary side within 1.2 or 1.9 hours (depending upon the available feedwater rate) core melting could be prevented. The efficiency of the use of residual heat removal chains, recirculated air coolers or steam generators to delay or prevent overpressuration of the containment after complete core melting have been analysed by calculations with the computer codes MARCH, CONDRU and KAVERN. The most efficient single action will be activating a residual heat removal chain within 24 hours and operating it intermittendly. This measure delays the overpressurization of the containment at least 2 months, or may even prevent overpressurization.

34866 (BMU—1986-119) Pre-study on an intended level-1 risk analysis for boiling water reactors. Bracht, K.; Kraut, A.; Schleifer, F.; Werner, W. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1986. 196p. (In German). (GRS-A—1143). NTIS, PC E14; Available from NTIS as TIB/B87-01425.

Schriftenreihe Reaktorsicherheit und Strahlenschutz. Ergebnisberichte, Untersuchungen, Studien, Gutachten.

The aim of this pre-study is, to give a survey on the present experiences with probabilistic risk assessment (PRA) for Boiling Water Reactors (BWR) and to evaluate these experiences with respect to an intended level-1 PRA for BWR in the Federal Republic of Germany. For this purpose it was analysed which technical issues should be treated in a level-1 PRA for BWR and on which areas work should be started. A survey was made on 18 PRA for BWR - situated in the USA, in Sweden, in Switzerland and in Austria. The PRA for Shoreham was evaluated in detail because a very good transferability of results could be expected in respect of the existing similarity to the KWU-BWR, type 72. The evaluation of the PRA's concerning the dynamic behaviour of BWR included the nuclear power plants Shoreham, Grand Gulf 1 and Millstone Point Unit 1. Because of the lack of sufficient experiences with the evaluation of uncertainty analyses for BWR-PRA, existing uncertainty analyses for PWR-PRA were used. The results of this pre-study are summarized, recommendations and comments are made for the performance of a level-1 PRA for BWR in the Federal Republic of Germany.

34867 **(BMU—1986-121) Assessment on a simple containment venting system to reduce the consequences of release category 6 sequences, accident without additional measures. Final report.** Hassmann, K.; Jeschke, J.; Weckesser, G.; Wuenschmann, D. (Bundesministerium fuer Umwelt, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.). Reaktorentwicklung). Sep 1984. 137p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-01434.

To determine the behavior of the steel containment of a KWU-type PWR a limit load investigation has been performed. The result was that leaks will occur at about 9 bar on the bolted connections of the material lock providing an orifice of about 50 to 300 cm/sup 2/. Based on a low pressure core meltdown sequence the gas transport will be possible through annulus and auxiliary building, excluding a gross failure of the steel containment. Therefore no additional containment venting equipment is necessary. With 21 refs., 11 tabs., 53 figs.

34868 **(CONF-860931—14) Results of transient overpower events on breached and unbreached fuel pins.** Strain, R.V.; Tsai, H.C.; Neimark, L.A.; Aratani, K. (Argonne National Lab., IL (USA); Power Reactor and Nuclear Fuel Development Corp., Oarai, Ibaraki (Japan). Oarai Engineering Center). Apr 1986. Contract W-31109-ENG-38. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87004993.

From International conference on reliable fuels for liquid metal reactors; Tucson, AZ, USA (7 Sep 1986).

The objective of the extended overpower tests on intact pins was to determine the pin cladding breaching thresholds vis-a-vis the Plant Protection System (PPS) trip settings, typically at ~10 to 15% overpower. These tests emphasize slow operational-type transients in light of earlier work which suggested that irradiated mixed-oxide fuel pins may be particularly vulnerable in the slow ramp-rate regime. An overview of the extended overpower test series was previously reported. More recent results on two of the tests in this series are included in this paper. These two tests, designated TOPI-1A and TOPI-1B, were each conducted on a 19-pin assembly with various pin design, operation and burnup variables. The overpower ramp rates for the TOPI-1A and -1B tests were 0.1%/s and 10%/s, respectively.

34869 **(DP-MS—86-152) Savannah River experience using a Cause Coding Tree to identify the root cause of an incident.** Paradies, M.W.; Busch, D.A. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 20p. (CONF-8610279—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010188.

From EPRI/NSAC annual independent safety analysis group conference; Houston, TX, USA (21 Oct 1986).

Incidents (or near misses) provide important information about plant performance and ways to improve that performance. Any particular incident may have several "root causes" that need to be addressed to prevent recurrence of the incident and thereby improve the safety of the plant. Also, by reviewing a large number of these incidents, one can identify trends in the root causes and generic concerns. A method has been developed at Savannah River Plant to systematically evaluate incidents, identify their root causes, record these root causes, and analyze the trends of these causes. By providing a systematic method to identify correctable root causes, the system helps the incident investigator to ask the right questions during the investigation. It also provides the independent safety analysis group and management with statistics that indicate existing and developing trouble sports. This paper describes the Savannah River Plant (SRP) Cause Coding Tree, and the differences between the SRP Tree and other systems used to analyze incidents. 2 refs., 14 figs.

34870 **(DPST—87-209) User's guide for Reactor Incident Root Cause Coding Tree.** Busch, D.A.; Paradies, M.W. (Savannah River Lab., Aiken, SC (USA)). 22 Dec 1986. Contract AC09-76SR00001. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010191.

The Reactor Incident (RI) Cause Coding Tree is designed to allow identification of root causes of RI's, thereby leading to trending of useful information and developing of corrective actions to prevent recurrence. This guide explains the terminology of the RI Cause Coding Tree and how to use the tree. Using this guide for cause coding is stressed to allow consistency of coding among all RI investigators. 8 figs.

34871 **(EPRI-NP—5184M) Snubber reduction program: Final report.** Landers, D.F.; Pace, R.M. (Teledyne Engineering Services, Waltham, MA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 32p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920437.

This report is a non-proprietary, edited version of EPRI RP1757-39, originally prepared by Teledyne Engineering Services. It contains historical information leading to an understanding of why such a large number of snubbers are used in commercial nuclear power plants in the United States and outlines recent and anticipated criteria changes which can bring about a reduction in the number of snubbers. The report also describes the development of a data base which contains basic snubber data for many nuclear power plants. Current utility snubber-reduction programs, available snubber-reduction information, and examples from piping systems assembled specifically for this study are summarized. Anticipated changes to plant documentation which are a necessary part of a snubber reduction program are described. Finally, recommendations are made to keep the data base and the procedures current with industry practice.

34872 **(EPRI-NP—5206) Contamination and decontamination experience with protective coatings at TMI-2 [Three Mile Island Unit 2]: Final report.** Schwartztrauber, K.E. (Pentek, Inc., Coraopolis, PA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 68p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920433.

A review has been conducted of the use of protective coatings in the nuclear industry with emphasis on the performance of Three Mile Island Unit 2 (TMI-2) coating systems. TMI recovery experiences; lessons learned with coatings; and research related to contamination, decontamination, and radioactivity penetration into epoxy coatings (qualified per 10CFR50, Appendix B, for use in the TMI-2 containment building) have been summarized. Technical findings compiled, and the generic implications of the TMI-2 data analyzed.

34873 (EUR—1006, pp 321-351) **Description of the approach to assuring nuclear installation safety reliability in the U.K. (Illustrated by reference to the proposed Sizewell PWR station).** Gittus, J.H.; Watson, I.A. (UKAEA, Safety and Reliability Directorate, Culcheth). 1985. Commission of the European Communities, Ispra, Italy. Joint Research Centre. (CONF-8410459—).

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

A review is given of the standards, regulations and procedures produced and utilised in the U.K. for assuring nuclear installation safety reliability. It concentrates on those relevant tot electricity power stations and is illustrated by the procedure applied to the proposed Sizewell B station. However, similar principles have been developed applying to nuclear reprocessing and waste management, and similar procedures are being applied. In the United Kingdom the Central Electricity Generating Board (CEGB) is responsible for the safety of its employees and the public from any nuclear hazards arising from its installations. The safety criteria and assessment procedures required by the CEGB are described in the paper. The safety requirements take into account the Safety Assessment Principles of the Nuclear Installations Inspectorate (NII) which are also discussed. The overall reliability requirements are discussed in detail with particular reference to protective systems. A brief description is presented of the degraded core accident analysis of the Sizewell "B" pressurized water reactor (PWR). This together with a presentation and discussion of the results of this probabilistc safety assessment was prepared for the Public Enquiry concerned with planning permission for the station. The frequency with which releases of activity would occur are shown to be considerably lower than required by the principles and regulations of the authorities concerned. 8 refs.

34874 (EUR—10006, pp 45-81) **System reliability.** Garribba, S.; Kafka, P. (Politecnico, Milano, Italy; GRS Forschungsgelaende, Garching, Germany, F.R.). 1985. Commission of the European Communities, Ispra, Italy. Joint Research Centre. (CONF-8410459—).

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

Event tree and fault tree are two-reliability-oriented techniques which find widespread use and complement each other, more particularly in nuclear reactor accident or safety analysis. Several algorithms and computer codes have been prepared for the construction and analysis of event and fault trees. The paper gives the reader a short account of the subject, although it does not contain the results of an original work. Rather, the attempt has been made to present the state-of-the-art in the World and in Europe. It is interesting to remark that a sizeable effort has been accomplished within the EEC in this respect, and that Europe hosts good development capacities. 45 refs.

34875 (EUR—10006, pp 116-145) **Theoretical and experimental research on the assessment of nuclear consequences.** Huebschmann, W.G. (Karlsruhe Nuclear Research Center, Germany, F.R.; Kelly, G.N., NRPB, Chilton Didcot, UK). 1985. Commission of the European Communities, Ispra, Italy. Joint Research Centre. (CONF-8410459—).

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

Nuclear accident consequence assessment has developed a research and development area of its own, since the reactor Safety Study, WASH-1400 has been issued in 1975. This report deals with the assessment of the radiological consequences of fission product releases from degraded core accidents in light water reactors. It is based mainly on the German Risk Study and on the UK Methodology for Assessing Radiological Consequences. The numerical models applied in the assessment are described and their specific problems which influence the type of submodels being used, are lined out. Special attention is paid to the various emergency actions for the protection of the population. It is pointed out which problems are still open to further reserarch and which lessons can eventually be learned from the nuclear risk studies. Some numerical results are given as an example of the capability of consequence assessment codes: the cumulative distribution functions of early and late fatalities and the cost of crop interdiction depending on the contamination threshold. Finally, the recent international cooperative research work is shortly described. 15 refs.

34876 (EUR—10006, pp 149-197) **Human factors considerations for reliability and safety.** Carnino, A. (Electricite de France, 75 - Paris. Direction Generale). 1985. Commission of the European Communities, Ispra, Italy. Joint Research Centre. (CONF-8410459—).

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

Human factors in many industries have become an important issue, since the last few years. They should be considered during the whole life time of a plant: design, fabriction and construction, licensing, operation. Improvements have been performed in the field of man-machine interface such as procedures, control room lay-out, operator aids, training. In order to meet the needs of reliability and probabilistic risk studies, quantification of human errors has been developed but needs still improvements in the field of cognitive behaviour, diagnosis and representation errors. Data banks to support these quantifications are still in a development stage. This applies to nuclear power plants and several examples are given to illustrate the above ideas. In conculsion, human factors field is in a very quickly evolving process but the tendency is still to adapt the man to machines whilst the reverse would be desirable.

34877 (EUR—10006, pp 198-246) **Software reliability.** Trauboth, H.; Ehrenberger, W. (KFK, Karlsruhe, Germany, F.R.; GRS Forschungsgelaende, Garching, Germany, F.R.). 1985. Commission of the European Communities, Ispra, Italy. Joint Research Centre. (CONF-8410459—).

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

Safety, reliability and availability of a nuclear plant can be increased by continuous monitoring, control of the significant process variables and operational parameters of the plant. These functions are usually realized by various on-line mini- and microcomputer systems which act and react in real-time. At present no method exists that guarantees computer programs to be free of errors. Several constructive means, however, exist which help to avoid errors during the program development process and tolerate certain errors during the operation. Other means allow to verify a certain cleanness from errors or a certain absence from operational failures. If the necessary effort is made, software can be made as reliable as required. 28 refs.

34878 **(HEDL-SA—3611-VT) Integrated accident analysis.** Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 27 Aug 1986. Contract AC06-76FF02170. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010219.

The Department of Energy has developed new capabilities to predict how an accident event would spread through a facility. These capabilities arose as a part of the development of a future generation accident code - CONACS. They can be used to predict the flow of fires, smoke, aerosols, explosive or toxic gases, radionuclides and other potentially dangerous conditions. Results from CONACS-type analysis can be used to improve design - the operation - and the safety of nuclear power plants. CONACS-related capabilities can also be adapted to analyze accident events in other facilities, such as factories, office buildings, mines, or ships - any facility that can be represented by compartments.

34879 **(IAEA-TC—579/21) A review of significant safety research results on Zircaloy fuel cladding deformation and coolability of deformed rod bundles in a LOCA [loss-of-coolant accident].** Erbacher, F.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente). 1986. 31p. (CONF-8611109—6). NTIS (US Sales Only), PC A03/MF A01. File Number DE87900496.

From IAEA technical committee meeting on water reactor fuel behaviour and fission products release in off-normal and accident conditions; Vienna, Austria (10 Nov 1986).

The paper summarizes the dominant effects which finally ensure the core coolability of a pressurized water reactor (PWR) in a loss-of-coolant accident (LOCA). The results presented relate mainly to research work performed at Karlsruhe Nuclear Research Center (KfK) on the deformation mechanisms of Zircaloy cladding tubes, the influence of thermal-hydraulics on cladding deformation and flow blockage and the coolability of deformed rod bundles: The main results are summarized as follows: the cooling effect of the two-phase mixture which is intensified during reflooding increases temperature differences on the cladding tube circumference and thus limits the mean circumferential burst strains to values of about 50%; a unidirected flow through the fuel rod bundle during the refill and reflooding phases causes maximum cooling channel blockage of about 70%; and the coolability of deformed fuel elements is improved by deformed and burst cladding tubes and can be maintained up to flow blockages of about 90%. All effects investigated indicate that in a LOCA no impairment of core coolability and public safety has to be expected.

34880 **(IKE—4-117) Detailed investigations on the core meltdown sequence using KESS-2. Research programme reactor safety. Final report.** Schmidt, F.; Bisanz, R.; Bleher, G.; Hocke, K.D.; Scheuermann, W.; Schindler, M.; Unger, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Oct 1984. 208p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-00228.

Results are obtained in the following areas: Comparison of theoretical and experimental results and measurements at TMI-II; limitations due to the use of simple models are demonstrated; consequences of the use of detailed models for the quality of the results are shown. Main results are: 1.) Temperatures and mass behavior can be predicted reasonably. 2.) Reactor Cores remain coolable even if they are partially empty during a longer period of time. 3.) To treat accidents with closed containments (Release Category 6) simple core models are sufficient. 4.) To treat accidents with failure of containment isolation (Release Category 2), detailed models are necessary. Main uncertainties arise from thermohydraulic boundary conditions and the modeling of fission product behavior. 5.) Condi-

tions for steam explosions with catastrophic consequences are very limited. However they cannot be excluded completely up to now. Detailed analyses for the 20 cm/sup 2/ LOCA and the loss of power accident support these findings.

34881 **(IKE—4-118) Development of software methods in view of PTS experiments. Pt. 1. Pre-investigations supporting the PTS experiments of the MPA Stuttgart.** Bisanz, R.; Bielmeier, M.; Burger, B.; Reusch, H.; Schmidt, F.; Wagner, A. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme; Stuttgart Univ. (Germany, F.R.). Abt. Reaktorsicherheit und Umwelt; Staatliche Materialpruefungsanstalt, Stuttgart (Germany, F.R.)). Sep 1984. 144p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-01121.

Complex experiments require modern software technologies for the analysis, interpretation, and presentation of experimental results. Such software is developed in view of the PTS (Pressurized Thermal Shock) experiment of the MPA in a cooperate effort by MPA and IKE both of the University of Stuttgart. The basic ideas of this system are reported. Also results of first applications in the field of fluid dynamics are given.

34882 **(LBL—23310) Interaction of uranium dioxide with molten zircaloy.** Kim, Kyu Tae. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87010987.

Laboratory experiments in which gram quantities of molten Zircaloy were held in contact with UO_2 for known times (20 to 600 s) and temperatures (1900 - 2200°C) were conducted. Sections were examined by optical microscopy, electron microprobe, scanning Auger microscopy, and X-ray fluorescence spectroscopy. In the first experiment, the molten metal was contained in a UO_2 crucible. The dissolution rate in this system was found to be dominated by natural convention in the melt driven by density gradients established by the dissolving uranium. The mechanism of the interaction also was observed to involve penetration and detachment of the grains of the oxide by the molten metal. Similar tests with single-crystal UO_2 specimens showed similar dissolution behavior. Less severe attach occurred because of the absence of grain boundaries, although subgrain boundaries or dislocations provided high-diffusivity pathways for preferential oxygen removal. In the third type of test, a disk of UO_2 was placed at the bottom of a ThO_2 crucible. This arrangement prevented establishment of unstable density gradients in the liquid phase, resulting in a purely diffusion-controlled interaction. A remarkable seven-region structure was observed in the quenched specimens. This structure could be explained by analysis of the quenching of the high-temperature interaction zone with the aid of the available ternary phase diagrams of the U-Zr-O system. The layers grew parabolically in time. The relevance of the data obtained to the melting on fuel pellets in a severe fuel damage accident was assessed.

34883 **(NUREG—1057-Suppl.5) Safety Evaluation Report related to the operation of Beaver Valley Power Station, Unit 2 (Docket No. 50-412).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1987. 174p. NTIS, PC A08/MF A01 - GPO. File Number TI87900764.

This report, Supplement No. 5 to the Safety Evaluation Report for the application filed by the Duquesne Light Company et al. (the applicant) for a license to operate the Beaver Valley Power Station, Unit 2 (Docket No. 50-412), has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement reports the status of certain items that had not been resolved when the Safety Evaluation Report and its Supplements 1, 2, 3, and 4 were published.

34884 (NUREG/CP—0082-Vol.1, pp 27-46) **Role of BWR MK I secondary containments in severe accident mitigation.** Greene, S.R. (Oak Ridge National Lab., TN). Feb 1987. (CONF-8610135—Vol.1). Contract AC05-84OR21400.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The recent advent of detailed containment analysis codes such as CONTAIN and MELCOR has facilitated the development of the first large-scale, architectural-based BWR secondary containment models. During the past year ORNL has developed detailed, plant-specific models of the Browns Ferry and Peach Bottom secondary containments, and applied these models in a variety of studies designed to evaluate the role and effectiveness of BWR secondary containments in severe accident mitigation. The topology and basis for these models is discussed, together with some of the emerging insights from these studies.

34885 (NUREG/CP—0082-Vol.1, pp 47-68) **Containment venting as a mitigation technique for BWR MARK I plant ATWS.** Harrington, R.M. (Oak Ridge National Lab., TN). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Containment venting is studied as a mitigation strategy for preventing or delaying severe fuel damage following hypothetical BWR Anticipated Transient Without Scram (ATWS) accidents initiated by MSIV-closure, and compounded by failure of the Standby Liquid Control (SLC) system injection of sodium pentaborate solution and by the failure of manually initiated control rod insertion. The venting of primary containment after reaching 75 psia (0.52 MPa) is found to result in the release of the vented steam inside the reactor building, and to result in inadequate Net Positive Suction Head (NPSH) for any system pumping from the pressure suppression pool. CONTAIN code calculations show that personnel access to large portions of the reactor building would be lost soon after the initiation of venting and that the temperatures reached would be likely to result in independent equipment failures. It is concluded that containment venting would be more likely to cause or to hasten the onset of severe fuel damage than to prevent or to delay it. Two alternative strategies that do not require containment venting, but that could delay or prevent severe fuel damage, are analyzed. BWR-LTAS code results are presented for a successful mitigation strategy in which the reactor vessel is depressurized, and for one in which the reactor vessel remains at pressure.

34886 (NUREG/CP—0082-Vol.1, pp 69-82) **Effects of lateral separation of oxidic and metallic core debris on the BWR MK I containment drywell floor.** Hyman, C.R.; Weber, C.F. (Oak Ridge National Lab., TN). Feb 1987. (CONF-8610135—Vol.1). Contract AC05-84OR21400.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In evaluating core debris/concrete interactions for a BWR MK I containment design, it is common practice to assume that at reactor vessel breach, the core debris is homogeneous and of low viscosity, so that it flows through the pedestal doorway and spreads in a radially uniform fashion throughout the drywell floor. In a recent study performed by the NRC-sponsored Boiling Water Reactor Severe Accident Technology (BWRSAT) program at Oak Ridge National Laboratory, calculations indicate that at reactor vessel bottom head failure, the debris temperature is such that the debris metals (Zr, Fe, Ni, Cr) are completely molten while the oxides (UO_2 ZrO_2, FeO) are completely frozen. Thus, the frozen oxides are expected to remain within the reactor pedestal while the molten metals radially separate from the frozen oxides, flow through the reactor pedestal doorway, and spread over the annular region of the drywell floor between the pedestal and the containment shell. This paper assesses the impact on calculated debris gas releases and the production and release of fission product-laden aerosols for two different cases of debris distribution: uniform distribution and the laterally separated case of 95% oxides-5% metals inside the pedestal and 5% oxides-95% metals outside the pedestal. The computer codes used are CORCON-MOD2, MARCON 2.1B and VANESA.

34887 (NUREG/CP—0082-Vol.1, pp 83-98) **Small break LOCA mitigation for Bellefonte.** Bayless, P.D.; Dobbe, C.A. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.1). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Several 5-cm (2-in.) diameter cold leg break loss of coolant accidents for the Bellefonte nuclear plant were analyzed as part of the Severe Accident Sequence Analysis Program. The transients as-

sumed various system failures, and included the S_2D sequence. Operator actions to mitigate the S_2D transient were also investigated. The transients were analyzed until either core damage began or long-term decay heat removal was established. The S_2D sequence was analyzed into the core damage phase of the transient. The analyses showed that the flow from one high pressure injection pump was necessary and sufficient to prevent core damage in the absence of operator actions. Operator actions were also able to prevent core damage for the S_2D sequence.

34888 (NUREG/CP—0082-Vol.1, pp 99-108) **Integrated SCDAP/RELAP5 analysis of a BWR high pressure boiloff.** Chambers, R. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.1). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A postulated high pressure boiloff in a boiling water reactor was analyzed using the SCDAP/RELAP5 computer code. Calculated damage to the core consisted of cladding failure, heavy oxidation, and relocation of molten core material. The slow cladding heatup rate allowed a thick zirconium dioxide shell to develop on the rod and channel surfaces, slowing oxidation and limiting relocation of core materials. The importance of multi-channel, integrated thermal-hydraulic and core behavior calculations was demonstrated by this boiloff simulation. The center of the core was heavily damaged, but the periphery remained intact. The cycling of the safety relief valves influenced zircaloy oxidation and hydrogen generation.

34889 (NUREG/CP—0082-Vol.1, pp 109-124) **Problems with industry's implementation of requirements for upgrading emergency operating procedures: a regulatory perspective.** Bongarra, J.P. Jr. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Following the Three Mile Island (TMI) accident, the Nuclear Regulatory Commission (NRC) established requirements for the commercial nuclear power industry to upgrade the adequacy of plant procedures, including emergency operating procedures (EOPs). These requirements specified in Generic Letter 82-33, Supplement 1 to NUREG-0737- Requirements for Emergency Response Capability, included reanalyzing transients and accidents, preparing technical guidelines and submitting Procedures Generation Packages (PGPs) from which plants could develop function-oriented, human factored EOPs. Generic Letter 82-33 also indicated that the staff would audit upgraded EOPs at selected facilities. This paper reviews the historical background of the requirements for upgrading EOPs and the industry's efforts to meet these requirements, assesses the success of the PGP concept as a technique for ensuring that quality EOPs are developed and implemented by the industry, and offers several options for improving the effort to upgrade EOPs.

34890 (NUREG/CP—0082-Vol.1, pp 125-138) **Uses of PRA in nuclear reactor regulation.** Congel, F. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

For the past five years, more than ten probabilistic risk assessment (PRA) studies were conducted by the owners of nuclear utilities and were submitted for the review of US Nuclear Regulatory Commission staff. These PRA studies were reviewed under various types of regulatory activities depending on the nature of plant licensing stage. The reviews of these PRAs provided very valuable uses to both the staff and the licensees on safety matters of the plant operation. The licensees developed perspectives using PRA models on the safety profiles of their plants. These PRA perspectives influenced licensees' major decisions to implement improvements to plant design and operating and emergency procedures to reduce and/or eliminate the plant's vulnerability to core damage accidents. The staff's review of these PRAs particularly emphasized the dominant accident sequences. The resulting findings led to the identification of dominant risk contributors, critical areas of plant locations, mechanisms leading to potential early containment failures, and instances of noncompliances of staff's deterministic criteria. Specific examples include single failure criterion and separation requirements to assess the need for any additional measures to further improve the safety of the plant. Some of these PRAs were reviewed under regulatory activities other than safety review such as environmental review, final design review, and licensing hearings. Most importantly, the risk profiles of generic PRAs will continue to be used in reviewing and evaluating unresolved safety issues and other generic issues. The major regulatory uses of PRAs, a summary of full scope PRA review, a summary of plant improvements as a result of PRA reviews, and the future role of PRA reviews are presented.

34891 (NUREG/CP—0082-Vol.1, pp 139-154) **Operational safety reliability research.** Hall, R.E.; Boccio, J.L. Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Operating reactor events such as the TMI accident and the Salem automatic-trip failures raised the concern that during a plant's operating lifetime the reliability of systems could degrade from the design level that was considered in the licensing process. To address this concern, NRC is sponsoring the Operational Safety Reliability Research project. The objectives of this project are to identify the essential tasks of a reliability program and to evaluate the effectiveness and attributes of such a reliability program applicable to maintaining an acceptable level of safety during the operating lifetime at the plant. Achieving high availability of safety systems involves both controlling the configuration of safety systems so that sufficient safety equipment is always available and providing safety systems that function reliably when challenged.

34892 (NUREG/CP—0082-Vol.1, pp 155-162) **Risk-based performance indicators.** Azarm, M.A.; Boccio, J.L.; Vesely, W.E.; Lofgren, E. Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The purpose of risk-based indicators is to monitor plant safety. Safety is measured by monitoring the potential for core melt (core-melt frequency) and the public risk. Targets for these measures can be set consistent with NRC safety goals. In this process, the performance of safety systems, support systems, major components, and initiating events can be monitored using measures such as unavailability, failure or occurrence frequency. The changes in performance measures and their trends are determined from the time behavior of monitored measures by differentiation between stochastical and actual variations. Therefore, degradation, as well as improvement in the plant safety performance, can be determined. The development of risk-based performance indicators will also provide the means to trace a change in the safety measures to specific problem areas which are amenable to root cause analysis and inspection audits. In addition, systematic methods will be developed to identify specific improvement policies using the plant information system for the identified problem areas. The final product of the performance indicator project will be a methodology, and an integrated and validated set of software packages which, if properly interfaced with the logic model software of a plant, can monitor the plant performance as plant information is provided as input.

34893 (NUREG/CP—0082-Vol.1, pp 163-178) **Procedures for evaluating technical specifications (PETS).** Samanta, P.K.; Boccio, J.L.; Vesely, W.E. Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In this paper, aspects of technical specifications relating to Generic Issues B-56 and B-61 are discussed from a risk-standpoint. These primarily deal with the risk issues associated with (1) adaptive diesel test requirements/surveillance test intervals, and (2) the effectiveness of cumulative outage time requirements for controlling downtime risk. Risk and reliability approaches are presented which (1) allow risk-acceptable test intervals to be determined for any diesel and (2) show the potential risk-control capability of prescribed allowed cumulative outage times. This work was conducted through NRC's Procedures for Evaluating Technical Specifications (PETS) Program. The overall objective of this program is to devel-

op and demonstrate methodologies that utilize risk insights and reliability techniques for evaluating the scope, detailed requirements, and safety impact of plant technical specifications.

34894 (NUREG/CP—0082-Vol.1, pp 179-192) **Overview of the plant risk status information management system.** Kirchner, J.R.; Campbell, D.J. (JBF Associates, Inc., Knoxville, TN). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Plant Risk Status Information Management System (PRISIM) is a personal computer program that presents PRA results and related information for use by decision-makers. The program was originally developed for NRC inspectors, but now an expanded version of the program with more potential applications is complete. Prototypes of both versions have been developed for Arkansas Nuclear One - Unit 1, and the inspection-related version is currently being field-tested. Interim results of these field tests are favorable. The PRISIM database contains both pre-processed information that is useful for long-term planning and a plant risk model for assessing the risk implications of the current plant status. The program provides rapid access to specific information by making extensive use of menus. Development of PRISIM programs for Peach Bottom-Unit 2 is underway, and there are plans to create programs for other plants.

34895 (NUREG/CP—0082-Vol.1, pp 193-208) **System analysis and risk assessment (SARA) system.** Krantz, E.A.; Russell, K.D.; Stewart, H.D.; Van Siclen, V.S. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.1). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Utilization of Probabilistic Risk Assessment (PRA) related information in the day-to-day operation of plant systems has, in the past, been impracticable due to the size of the computers needed to run PRA codes. This paper discusses a microcomputer-based database system which can greatly enhance the capability of operators or regulators to incorporate PRA methodologies into their routine decision making. This system is called the System Analysis and Risk Assessment (SARA) system. SARA was developed by E.G. & G. Idaho, Inc. at the Idaho National Engineering Laboratory to facilitate the study of frequency and consequence analyses of accident sequences from a large number of light water reactors (LWRs) in this country. This information is being amassed by several studies sponsored by the US Nuclear Regulatory Commission (USNRC). To meet the need of portability and accessibility, and to perform the variety of calculations necessary, it was felt that a microcomputer-based system would be most suitable.

34896 (NUREG/CP—0082-Vol.1, pp 209-220) **Management of generic safety issues.** Minners, W. Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The history and current program of generic safety issue management at the US Nuclear Regulatory Commission are reviewed. The process and procedure of identifying, prioritizing, resolving, imposing, implementing and verifying generic safety issues and their resolution are presented including the method of prioritizing resource allocation based on the potential risk reduction and costs of implementing the resolution of issues.

34897 (NUREG/CP—0082-Vol.1, pp 221-234) **Accident characterization methodology.** Camp, A.L.; Harper, F.T. (Sandia National Labs., Albuquerque). Feb 1987. (CONF-8610135—Vol.1). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Nuclear Regulatory Commission (NRC) is preparing NUREG-1150 to examine the risk from a selected group of nuclear power plants. NUREG-1150 will provide technical bases for comparison of NRC research to industry results and resolution of numerous severe accident issues. In support of NUREG-1150, Sandia National Laboratories has directed the production of Level 3 Probabilistic Risk Assessments (PRAs) for the Surry, Sequoyah, Peach Bottom, and Grand Gulf nuclear power plants. The Accident Sequence Evaluation Program (ASEP) at Sandia has been responsible for the Level 1 portion of the analyses, which includes estimation of core damage frequency and characterization of the dominant sequences. The ASEP analyses are being documented in NUREG/CR-4550. The purpose of this paper is to briefly describe and evaluate the methodology utilized in these analyses. The four Level 1 PRAs have several objectives. They provide estimates of the internal event core-damage frequencies for the four plants along with identification of the dominant accident sequences and the events that drive those sequences. Uncertainty and sensitivity analyses are presented for each plant.

34898 (NUREG/CP—0082-Vol.1, pp 235-254) **Results of core damage frequency analysis for the reference plants.** Harper, F.T.; Bertucio, R.C.; Drouin, M.T.; Kolaczkowski, A.M.; Wheeler, T.A. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.1). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Nuclear Regulatory Commission (NRC) is preparing NUREG-1150 to examine risk from a selected group of nuclear power plants. NUREG-1150 will provide a basis for comparison of NRC research to industry results and resolution of numerous severe accident issues. In support of NUREG-1150, Sandia National Laboratories has directed the production of NUREG/CR-4550. NUREG/CR-4550 includes Level 1 Probabilistic Risk Assessments (PRAs) for the Surry, Sequoyah, Peach Bottom, and Grand Gulf nuclear power plants and a limited reanalysis of the Zion PRA. A brief summary of the current results of these five analyses is presented in this paper. A paper describing and evaluating the methodology used to perform the four Level 1 PRAs will also be presented at this conference.

34899 (NUREG/CP—0082-Vol.1, pp 255-274) **Analysis of containment venting at the Peach Bottom atomic power station.** Hanson, D.J.; Blackman, H.S.; Nelson, W.R.; Wright, R.E.; Leonard, M.T.; DiSalvo, R. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. (CONF-8610135—Vol.1). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An analysis of the extent to which containment venting would be effective in preventing or mitigating the consequences of severe accidents has been completed for the Peach Bottom Atomic Power Station, Units 2 and 3 (BWR-4s with Mark I containments). The analysis indicates that the effectiveness of venting in preventing containment overpressurization highly depends on the sequence of the severe accident. Containment venting can be effective for several classes of sequences, including transients with failure of long-term decay heat removal and loss-of-coolant accidents with breaks inside the containment. However, based on draft procedures and equipment in place at the time of the evaluation, containment venting has limited potential for further reducing the risk associated with three severe accident sequences currently identified as important risk contributors at Peach Bottom. Means of improving the potential for risk reduction is identified, but their influence on risk is not analyzed.

34900 (NUREG/CP—0082-Vol.1, pp 275-300) **Risk uncertainty analysis methods for NUREG-1150.** Benjamin, A.S.; Boyd, G.J. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Evaluation and display of risk uncertainties for NUREG-1150 constitute a principal focus of the Severe Accident Risk Rebaselining/Risk Reduction Program (SARRP). Some of the principal objectives of the uncertainty evaluation are: (1) to provide a quantitative estimate that reflects, for those areas considered, a credible and realistic range of uncertainty in risk; (2) to rank the various sources of uncertainty with respect to their importance for various measures of risk; and (3) to characterize the state of understanding of each aspect of the risk assessment for which major uncertainties exist. This paper describes the methods developed to fulfill these objectives.

34901 (NUREG/CP—0082-Vol.1, pp 301-334) **Risk and risk reduction results for Surry, obtained in support of NUREG-1150.** Benjamin, A.S.; Boyd, G.J. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.1). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Severe Accident Risk Rebaselining/Risk Reduction Program has completed a rebaselining of the risks to the public from a particular pressurized water reactor with a subatmospheric containment (Surry, Unit 1). Emphasis was placed on determining the magnitude and character of the uncertainties, rather than focusing on a point estimate. The risk reduction potential of a set of proposed safety option backfits was also studied, and their costs and benefits were evaluated. It was found that the risks from internal events are generally lower than previously evaluated in the Reactor Safety Study (RSS). However, certain unresolved issues (such as direct containment heating) cause the top of the uncertainty band to appear at a level that is comparable with the RSS point estimate. None of the postulated safety options appears to be cost-effective for the Surry power plant.

34902 (NUREG/CP—0082-Vol.1, pp 335-352) **Development and status of MELCOR.** Haskin, F.E.; Webb, S.W.; Summers, R.M. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.1). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

MELCOR is a fully integrated, relatively fast-running code which models the progression of severe accidents in light water reactor nuclear power plants. An entire spectrum of severe accident phenomena is modeled in MELCOR. Characteristics of severe accident progression that can be treated with MELCOR include the thermal hydraulic response in the reactor coolant system, reactor cavity, containment, and confinement buildings; core heatup and degradation; hydrogen production, transport and combustion; core-concrete attack; heat structure response; radionuclide release and transport; and the impact of engineered safety features on thermal hydraulic and radionuclide behavior. MELCOR is being developed at Sandia National Laboratories for the US Nuclear Regulatory Commission (NRC) to succeed the Source Term Code Package. MELCOR has been designed to facilitate sensitivity and uncertainty analyses, and is currently being used to estimate severe-accident progression, source terms and associated sensitivities and uncertainties for two NRC-sponsored PRAs.

34903 (NUREG/CP—0082-Vol.1, pp 353-378) **Analysis of Peach Bottom station blackout with MELCOR.** Dingman, S.E.; Cole, R.K.; Haskin, F.E.; Summers, R.M.; Webb, S.W. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.1). Contract AC04-76DP00789.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A demonstration analysis of station blackout at Peach Bottom has been performed using MELCOR and the results have been compared with those from MARCON 2.1B and the Source Term Code Package (STCP). MELCOR predicts greater in-vessel hydrogen production, earlier melting and core collapse, but later debris discharge than MARCON 2.1B. The drywell fails at vessel breach in MELCOR, but failure is delayed about an hour in MARCON 2.1B. These differences are mainly due to the MELCOR models for candling during melting, in-core axial conduction, and continued oxidation and heat transfer from core debris following lower head dryout. Three sensitivity calculations have been performed with MELCOR to address uncertainties regarding modeling of the core-concrete interactions. The timing of events and the gas and radionuclide release rates are somewhat different in the base case and the three sensitivity cases, but the final conditions and total releases are similar.

34904 (NUREG/CP—0082-Vol.1, pp 379-396) **MELCOR validation results.** Leigh, C.D.; Byers, R.K.; Shaffer, C.J. (Sandia National Labs., Albuquerque, NM). Feb 1987. (CONF-8610135—Vol.1). Contract AC04-76DP00789.

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Recent comparisons of MELCOR predictions to three sets of experiments, the ABCOVE Aerosol Experiments, the HDR-V44 Steam Blowdown Experiments, and the Battelle-Frankfurt Gas Mixing Experiments are presented. All three comparisons involve conditions that are of concern in an LWR containment during a severe accident. MELCOR results are compared to the experimental data and the predictions of at least one other state-of-the-art code for each test. In the ABCOVE comparisons, the MELCOR aerosol modeling is demonstrated. In comparisons to the HDR-V44 Steam Blowdown Experiments, MELCOR predictions of the response of the containment to the release of steam from the primary system are shown, and in the Battelle-Frankfurt comparisons, MELCOR predictions of the diffusion in a containment of an injected hydrogen-nitrogen gas are studied. These comparisons provide critical testing of the MELCOR control volume hydrodynamics package, the radionuclide package, and the flow path package.

34905 (NUREG/CP—0082-Vol.1, pp 397-400) **Safe environment for demonstrating advanced reactors.** Dooley, J.L.; Hammond, R.P. (Telephos, Santa Monica, CA). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Well-known cold-trapping technology has been applied on a larger scale than heretofore, to provide a vent-filter system for reactor containments that is capable of handling a full scale core-melt accident with no external release of radioactive material. The filter-trap is passive in operation, requiring no electric power or moving parts during an accident. With containment vented at all times, the possibility of overpressure leakage or failure is removed, and an evacuation plan would be unnecessary. Such a containment system would provide a safe environment for demonstrating untested reactors with high acceptance from the public.

34906 (NUREG/CP—0082-Vol.1, pp 401-416) **Examination of the bases for proposed innovations in reactor safety technology.** Moses, D.L. (Oak Ridge National Lab., TN). Feb 1987. (CONF-8610135—Vol.1). Contract AC05-84OR21400.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper employs the criteria for evaluations from the Nuclear Power Option Viability Study to examine the bases for proposed innovations in light water reactor safety technology. These bases for innovation fall into four broad categories as follows: (1) virtually exclusive reliance on passive safety features to preclude core damage in all situations, (2) design simplification using some passive safety features to reduce the frequency of core damage to less than about 10^{-6} per reactor-year, (3) passive containment to preclude releases from any accident, and (4) designing to limit licensing attention to one or at least a few systems. Of these, only the first two, and perhaps only the second, hold significant promise for providing for the viability of advanced light water reactors.

34907 (NUREG/CP—0082-Vol.1, pp 417-442) **Reconfigured PWR with ultra-safe characteristics.** Schultz, M.A. (Pennsylvania State Univ., University Park). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An ultra-safe PWR that can sit indefinitely with a complete loss of power is described. The principal difference from conventional plants is the methods of primary pressurization which is accomplished by a charging pump fed from an atmospheric pressure tank located above the reactor. The pump is a high reverse leakage Francis type that becomes a turbine generator in the reverse direction. At shutdown the primary system blows off through the turbine - generator and supplies power to an HPI pump to put as much or more water back into the primary system as was lost during the blow-off. After approximately 7 hours after shutdown the pressure has fallen enough to flood the system by gravity from the atmospheric tank. Natural circulation for primary to secondary heat transfer is provided as well as a dedicated secondary passive sink for decay heat. Cleanup of radioactive gases and liquids is ac-

complished at atmospheric pressure, and pipe or pressure vessel break leakage is returned automatically to the atmospheric tank.

34908 (NUREG/CP—0082-Vol.1, pp 443-464) **Advanced light water reactors for the nineties.** Ross, F.A.; Sugnet, W.R. (Dept. of Energy, Washington, DC). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The EPRI/Industry advanced light water reactor (ALWR) program and the US Department of Energy ALWR program are closely coordinated to meet the common objective which is the availability of improved and simplified light water reactor plants that may be ordered in the next decade to meet new or replacement capacity requirements. The EPRI/Industry objectives, program participants, and foreign participants, utility requirements document, its organization and content, small plant conceptual design program, the DOE ALWR program, design verification program, General Electric ABWR design features, Combustion Engineering system design, mid-size plant development, General Electric SBWR objectives, Westinghouse/Burns and Roe design objectives, construction improvement, and improved instrumentation and control are discussed in the paper.

34909 (NUREG/CP—0082-Vol.1, pp 465-484) **Impact of passive safety requirements on plant design.** Gavigan, F.X.; Nulton, J.D.; Humphreys, J.R.; Millunzi, A.C. (Dept. of Energy, Washington, DC). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

Over the past 2 years, the US Department of Energy (DOE) has been actively involved with contractor design organizations throughout the US to develop modular Liquid Metal Reactors (LMR's) and High Temperature Gas Reactors (HTGR's) that reflect increased passive safety, decreased costs, and high reliability. The emphasis on passive safety has led to a number of beneficial outcomes in the form of reduced costs, different safety philosophies, simpler plant designs, lower operating costs, and increased safety margins. Features such as air cooling for removal of decay heat, magnetic curie switches to cause rod drop, core designs that produce inherently safe cores, and others have resulted in a reexamination of the need for safety-grade control rooms and a move away from reliance on redundancy and diversity in engineered safety systems toward heat removal and reactivity control through the action of passive devices and inherent characteristics. The result to date has been reactors that are reduced in risk and in cost, which are simpler to operate and simpler to maintain and that may well meet the US Environmental Protection Agency's (EPA's) Protection Action Guides (PAG's) inside the site boundary thereby introducing the possibility of eliminating the need for evacuation planning.

34910 (NUREG/CP—0082-Vol.1, pp 485-513) **NucleDyne's passive containment system.** Falls, O.B. Jr.; Kleimola, F.W. (NucleDyne Engineering Corp., Jackson, MI). Feb 1987. (CONF-8610135—Vol.1).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A simple definition of the passive containment system is that it is a total safeguards system for light water reactors designed to prevent and contain any accidental release of radioactivity. Its passive features utilize the natural laws of physics and thermodynamics. The system encompasses three basic containments constructed as one integrated structure on the reactor building foundation. The primary containment encloses the reactor pressure vessel and coolant system and passive engineered safety systems and components. Auxiliary containment enclosures house auxiliary systems and components. Secondary containment (the reactor building), housing the primary and auxiliary containment structures, provides a second containment barrier as added defense-in-depth against leakage of radioactivity for all accidents assumed by the industry. The generic features of the passive containment system are applicable to both the boiling water reactors and the pressurized water reactors as standardized features for all power ranges. These features provide for a zero source term, the industry's ultimate safety goal. This paper relates to a four-loop pressurized water reactor.

34911 (NUREG/CP—0082-Vol.2, pp 1-18) **Evaluation and improvement of nondestructive evaluation reliability for inservice inspection of light water reactors.** Bates, D.J.; Deffenbaugh, J.D.; Good, M.S.; Heasler, P.G.; Mart, G.A.; Simonen, F.A.; Spanner, J.C.; Taylor, T.T.; Van Fleet, L.G. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract AC06-76RL01830.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Evaluation and Improvement of NDE Reliability for Inservice Inspection (ISI) of Light Water Reactors (NDE Reliability) Program at Pacific Northwest Laboratory (PNL) was established to determine the reliability of current ISI techniques and to develop recommendations that will ensure a suitably high inspection reliability. The objectives of this NRC program are to: determine the reliability of ultrasonic ISI performed on commercial light-water reactor (LWR) primary systems, using probabilistic fracture mechanics analysis, determine the impact of NDE unreliability on system safety and determine the level of inspection reliability required to ensure a suitably low failure probability, evaluate the degree of reliability improvement that could be achieved using improved and advanced NDE techniques, based on material properties, service conditions, and NDE uncertainties, recommend revisions to ASME Code, Section XI, and Regulatory Requirements that will ensure suitably low failure probabilities. The scope of this program is limited to ISI of primary systems; the results and recommendations may also be applicable to Class II piping systems.

34912 (NUREG/CP—0082-Vol.2, pp 19-42) **Development and validation of a real-time SAFT-UT system for inservice inspection of light water reactors.** Doctor, S.R.; Hall, T.E.; Reid, L.D.; Mart, G.A.; Littlefield, R.; Gilbert, R. (Battelle Memorial Institute, Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract AC06-76RL01830.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A multi-year program is underway at Pacific Northwest Laboratory (PNL) to move the synthetic aperture focusing technique from the laboratory into the field for the purpose of inspecting light water reactor (LWR) components. The objectives of the program are: 1) design, fabricate, and evaluate a real-time flaw detection and characterization system based on SAFT-UT for inservice inspection of all required LWR components. 2) Establish calibration and field test procedures. 3) Demonstrate and validate the system through actual field reactor inspections. 4) Generate an engineering data base to support Code acceptance of the real-time SAFT-UT technique. The program scope is defined by the following: conduct laboratory tests to provide engineering data for defining SAFT-UT system performance. Complete the development of a special processor to make SAFT a real-time technique for ISI application. Fabricate and field test a fieldable real-time SAFT-UT system on nuclear reactor piping, nozzles, and pressure vessels. This report is a summary of the highlights from the fourth year's efforts. The work presented here includes: alternate SAFT-UT tandem configuration development (TSAFT-2), SAFT-UT parameter sensitivity analysis, real-time SAFT processor development, and SAFT-UT data collection and analysis.

34913 (NUREG/CP—0082-Vol.2, pp 43-56) **Progress for on-line acoustic emission monitoring of cracks in reactor systems.** Hutton, P.H.; Friesel, M.A.; Kurtz, R.J. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper discusses program activities to develop "Acoustic Emission/Flaw Relationships for Inservice Monitoring of LWRs. The work is sponsored by the NRC Research Office with TVA currently providing supplemental funding. Accomplishments for FY86 and plans for FY87 are reviewed under the topics of reactor monitoring. AE signal pattern recognition. IGSCC/AE relationships, and standards and code work. Current program emphasis is

on technology transfer including validating the technology on-reactor and establishing the technology in national standards and codes.

34914 (NUREG/CP—0082-Vol.2, pp 57-68) **Reliability of leak detection systems in light water reactors.** Kupperman, D.S. (Argonne National Lab., IL). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract W-31-109-ENG-38.

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US Nuclear Regulatory Commission Guide 1.45 recommends the use of at least three different detection methods in reactors to detect leakage. Monitoring of both sump-flow and airborne particulate radioactivity is recommended. A third method can involve either monitoring of condensate flow rate from air coolers or monitoring of airborne gaseous radioactivity. Although the methods currently used for leak detection reflect the state of the art, other techniques may be developed and used. Since the recommendations of Regulatory Guide 1.45 are not mandatory, the technical specifications for 74 operating plants have been reviewed to determine the types of leak detection methods employed. In addition, Licensee Event Report (LER) Compilations from June 1985 to June 1986 have been reviewed to help establish actual capabilities for detecting leaks and determining their source. Work at Argonne National Laboratory has demonstrated that improvements in leak detection, location, and sizing are possible with advanced acoustic leak detection technology.

34915 (NUREG/CP—0082-Vol.2, pp 69-100) **Program for the inspection of steel components PISC II results and PISC III plans.** Crutzen, S.J. Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

For several years the question has been asked: are NDE techniques used on heavy sections sufficiently effective and reliable to satisfy the requirements for integrity assessment of important structures such as pressure vessels. The series of major cooperative programs known collectively as PISC (the Program for the Inspection of Steel Components) has been developed progressively to provide as complete an answer as possible to these questions on the capability of NDE. PISC involves three stages. PISC II the second stage, was set up in 1980 by OECD and CEC to examine in more detail which techniques could provide the desired level of capability for detecting and sizing defects. The experimental work of this phase has been completed successfully to the planned program, the evaluation of the results is completed and the objectives are reached.

34916 (NUREG/CP—0082-Vol.2, pp 101-118) **BWR pipe crack remedies evaluation.** Shack, W.J.; Kassner, T.F.; Maiya, P.S.; Park, J.Y.; Ruther, W.E. (Argonne National Lab., IL). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract W-31-109-ENG-38.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper presents results on (a) the influence of simulated BWR environments on the stress-corrosion-cracking (SCC) susceptibility of Types 304, 316NG< and 347 stainless steel (SS), (b) fracture-mechanics crack growth rate measurements on these materials and weld overlay specimens in different environments, and (c) residual stress measurements and metallographic evaluations of conventional pipe weldments treated by a mechanical-stress-improvement process (MSIP) as well as those produced by a narrow-gap welding procedure. Crack initiation studies on Types 304 and 316NG SS under crevice and non-crevice conditions in 289°C water containing 0.25 ppm dissolved oxygen with low sulfate concentrations indicate that SCC initiates at very low strains (<3%) in the nuclear grade material. Crack growth measurements on fracture-mechanics-type specimens, under low-frequency cyclic loading, show that the Type 316NG steel cracks at a somewhat lower rate (~40%) than sensitized Type 304 SS in an impurity environment with 0.25 ppm dissolved oxygen; however, the latter material stops cracking when sulfate is removed from the water. Crack growth in both materials ceases under simulated hydrogen-water chemistry conditions (<5 ppb oxygen) even with 100 ppb sulfate present in the water. An unexpected result was obtained in the test on a weld overlay specimen in the impurity environment, viz., the crack grew to the overlay interface at a nominal rate, branched at 90° in both directions, and then grew at a high rate (parallel to the nominal applied load). Residual stress measurements on MSIP-treated weldments and those produced by a narrow-gap welding procedure indicate that these techniques produce compressive stresses over most of the inner surface near the weld and heat-affected zones.

34917 (NUREG/CP—0082-Vol.2, pp 119-142) **Aging degradation of cast stainless steel.** Chopra, O.K.; Chung, H.M. (Argonne National Lab., IL). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A program is being conducted to investigate the significance of in-service embrittlement of cast duplex stainless steels under light-water reactor operating conditions. Microstructures of cast materials subjected to long-term aging either in reactor service or in the laboratory have been characterized by TEM, SANS, and APFIM techniques. Two precipitate phases, i.e., the Cr-rich α' phase and the Ni- and Si-rich G phase, have been identified in the ferrite matrix of the aged steels. The results indicate that the low-temperature embrittlement is primarily caused by α' precipitates which form by spinodal decomposition. The relative contribution of the G phase to loss of toughness is now known. Microstructural data also indicate that weakening of the ferrite/austenite phase boundary by carbide precipitates has a significant effect on the onset and extent of embrittlement of the high-carbon CF-8 and CF-8M grades of stainless steels, particularly after aging at 400 or 450°C. Data from Charpy-impact, tensile, and J-R curve tests for several heats of cast stainless steel aged up to 10,000 h at 350, 400, and 450°C are presented and correlated with the microstructural results. Thermal aging of the steels results in an increase in tensile strength and a decrease in impact energy, J/sub IC/, and tearing modulus. The fracture toughness results show good agreement with the Charpy-impact data. The effects of compositional and metallurgical variables on loss of toughness are discussed.

34918 (NUREG/CP—0082-Vol.2, pp 143-170) **Surry steam generator - examination and evaluation.** Bickford, R.L.; Bradley, E.R.; Clark, R.A.; Doctor, P.G.; Ferris, R.H.; Fetrow, L.K.; Lewis, M. (Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

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The Steam Generator Group Project, an NRC program with joint sponsorship by EPRI and consortia from France, Italy and Japan, is in the final year of a five year research program. The program utilizes the retired-from-service Surry steam generator, with a major objective of developing data on the reliability of detection and accuracy of defect sizing provided by current practice eddy current in-service inspection (ISI). In addition to defining the performance of current field practice NDE, the program is also evaluating alternate or advanced NDE techniques for the ISI characterization of steam generators. Validation of NDE is provided through the removal of specimens from the generator, with subsequent destructive and out-of-generator non-destructive examination. In addition, service defected tubes will be subject to burst testing to validate previously developed models on tube integrity. The ultimate programmatic goals are to integrate the NDE validation and remaining tube integrity information to provide inputs to NRC on in-service inspections and tube plugging criteria. Project accomplishments during the past year are discussed.

34919 (NUREG/CP—0082-Vol.2, pp 171-194) **Effect of crack shape and variable amplitude loading on fatigue crack growth in PWR environments.** Cullen, W.H. (Materials Engineering Associates, Inc., Lanham, MD). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

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Plate specimens (25 mm x 100 mm) have been prepared with 10 mm x 20 mm (a x 2c) part-through surface cracks located on the center line. Specimens have been fabricated from both clad and unclad pressure vessel and piping steels. Fatigue crack growth rate tests in air environments indicate that crack shape is highly dependent on test temperature. At high temperatures, the width-to-depth ratio is decreased significantly. For clad steels, the tensile stresses in the clad at low (room) temperature result in increased crack opening forces and a large width to depth ratio. The effect of variable amplitude loading has been studied through a program of test matrices of increasing complexity. Initial variable amplitude testing was in a dry helium gas environment in order to ascertain the effects of single and multiple overload and underload schemes without the complex effects of a PWR environment. Later tests employed more complex spectra, containing blocks of spectral components with load ratios simulating start-up/shut-downs, normal power loadings and unloadings, and simple reactor or turbine trips. After completion of testing in helium gas environments, the testing in PWR environments was initiated, with the result that crack extension in a block was essentially dependent on the test frequency of the spectral components.

34920 (NUREG/CP—0082-Vol.2, pp 195-222) **Integration of wide-plate crack-arrest test results.** Pugh, C.E.; Naus, D.J. (Oak Ridge National Lab., TN). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract AC05-84OR21400.

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The HSST wide-plate crack-arrest tests are designed to provide fracture-toughness measurements at temperatures approaching or above the onset of the Charpy upper-shelf regime, in a rising toughness region and with an increasing driving force. The tests are being performed at the National Bureau of Standards (NBS), Gaithersburg, Maryland, in their 27-MN-capacity testing machine. To date, eight tests have been completed, six utilizing specimens fabricated from HSST plate 13A of A533 grade B class 1 steel (WP-1 Series) and two specimens fabricated from a low upper-shelf base material (WP-2 Series). Each test utilized a single-edge notched (SEN) plate specimen (1 by 1 by x m, where x equaled either 0.1 or 0.15) that was subjected to a linear thermal gradient along the plane of crack propagation. Results obtained from the WP-1 test series exhibit a significant increase in toughness at temperatures near and above the onset of Charpy upper shelf (T/sub CVN/ = 55°C). Additionally, cleavage crack propagation and arrest at temperatures above the onset of Charpy upper shelf have been demonstrated. Also, when K/sub Ia/ vs T - RTNDT data from Series WP-1 are combined with data from other large specimen tests, a consistent trend is formed and K/sub Ia/ values extend above the existing ASME reference fracture curve.

34921 (NUREG/CP—0082-Vol.2, pp 223-250) **Viscoplastic analyses of large crack-arrest specimens with various constitutive equations and fracture criteria.** Bass, B.R.; Pugh, C.E.; Keeney-Walker, J.; Schwartz, C.W. (Oak Ridge National Lab., TN). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract AC05-84OR21400.

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A primary objective of the crack-arrest studies being conducted by the Heavy-Section Steel Technology (HSST) program is to understand pressure vessel conditions that would initiate growth of an existing crack and conditions that would lead to arrest of a moving crack. In meeting this objective, the HSST program is generating crack-arrest data over an expanded temperature range through tests involving large cylinders, pressure vessels and wide-plate specimens. The role of nonlinear rate-dependent effects in the interpretation of crack run-arrest events in ductile material is being investigated by the HSST program through development and applications of viscoplastic-dynamic finite element analysis techniques. This paper describes a portion of these studies that relate to the installation of two viscoplastic constitutive models and several proposed fracture criteria into the ADINA finite element program. The formulations of the Perzyna and the Bodner-Partom constitutive models that were installed in ADINA are presented, including a compilation of material parameters for these models obtained from dynamic stress-strain data for A533 grade B class 1 steel. This is followed by a description of path-independent integrals J', T* (from Nishioka and Atluri) and J (from Kishimoto) installed in the ADINA program. Finally, the combined predictive capabilities of these techniques are applied to the analysis of a wide-plate crack-arrest test recently conducted by the HSST program.

34922 (NUREG/CP—0082-Vol.2, pp 251-272) **Brittle-ductile transition behavior in reactor vessel steels.** Irwin, G.R. (Univ. of Maryland, College Park). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

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The brittle-to-ductile transition of structural steel, with increase of temperature, plays a basic role in the fracture safety of nuclear reactor vessels. The NRC HSST program has been concerned with relevant aspects of this behavior since its inception. It has been recognized that problems remain which are related to the influences of constraint and loading rate in small specimen testing. Comparisons of small specimen results with initiation and arrest data from thermal shock testing of cylinders at ORNL have been of special value. Risk calculations brought out the importance of crack arrest toughness information at temperatures near loss of cleavage temperature. Along with the needs for methods of predicting rapid fracture behavior, this led to dynamic analysis computer programs and the current program of wide-plate tests at NBS. In addition to producing macroscopic test information of direct applicability, the program has recognized that improvements in the depth of understanding of cleavage-to-fibrous transition behaviors are desirable. A better understanding of initiation and spreading of cleavage, particularly in regard to influences of constraint and loading rate, can improve the efficiency in the development and use of fracture test information. For optimum benefits of this kind, they need not only a range of fracture test information but also an understanding of the fine-scale separational events which control the trends and the variability of fracture test results. This paper summarizes recent progress toward improved understanding of fine-scale separational events.

34923 (NUREG/CP—0082-Vol.2, pp 273-285) **Flaw density examinations of a clad boiling water reactor pressure vessel segment.** Cook, K.V.; McClung, R.W. (Oak Ridge National Lab., TN). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract AC05-84OR21400.

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Flaw density is the greatest uncertainty involved in probabilistic analyses of reactor pressure vessel failure. As part of the Heavy-Section Steel Technology (HSST) Program, studies have been conducted to determine flaw density in a section of reactor pressure vessel cut from the Hope Creek Unit 2 vessel [nominally 0.7 by 3 m (2 by 10 ft)]. This section (removed from the scrapped vessel that was never in service) was evaluated nondestructively to determine the as fabricated status. The project had four primary objectives: (1) evaluate longitudinal and girth welds for flaws with manual ultrasonics, (2) evaluate the zone under the nominal 6.3-mm (0.25-in.) clad for cracking (again with manual ultrasonics), (3) evaluate the cladding for cracks with a high-sensitivity fluorescent penetrant method, and (4) determine the source of indications detected. The seam welds were located by grinding and etching procedures and the boiling water reactor (BWR) vessel cylindrical segment was cut into four samples so that both nondestructive and destructive testing could be performed.

34924 (NUREG/CP—0082-Vol.2, pp 287-298) **PTSE-2: HSST pressurized thermal shock experiment with low upper-shelf energy toughness material.** Bryan, R.H.; Bryson, J.W.; Nanstad, R.K.; Bolt, S.E.; Merkle, J.G.; Robinson, G.C. (Oak Ridge National Lab., TN). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2). Contract AC05-84OR21400.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The second pressurized thermal shock experiment (PTSE-2) of the Heavy-Section Steel Technology Program was conceived to investigate fracture behavior of steel with low ductile-tearing resistance. In overcooling accidents, damage by fracture is potentially a problem of serious concern only in instances of vessel materials that have high transition temperatures and low Charpy impact energies at upper-shelf temperatures. In some cases the outcome of an overcooling accident analysis is principally determined by the transition temperature of the material and its influence on the initiation of brittle fracture; in such cases, low tearing resistance concomitant with low impact energy may be unimportant. If, however, crack arrest is also a contributing factor, then ductile tearing should also be considered. An arrested cleavage crack may be unstable with respect to ductile tearing. PTSE-2 is designed to produce a cleavage arrest under conditions that will immediately induce unstable tearing. The flawed material in the test vessel was fabricated to have low toughness at Charpy upper-shelf temperatures. It is the principal objective of this test to elucidate this fracture process. A secondary objective of PTSE-2 is to extend the investigation of warm prestressing that was started in the first pressurized thermal shock experiment.

34925 (NUREG/CP—0082-Vol.2, pp 299-323) **Evaluation of surface cracks embedded in reactor vessel cladding.** McCabe, D.E. (Materials Engineering Associates, Inc., Lanham, MD). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The surface crack embedded in the clad layer of a reactor vessel has been identified as a critical safety assessment condition relative to the pressurized thermal shock accident scenario. This project was initiated to determine the severity of such cracks experimentally, using irradiated material, and to identify the material property and stress conditions in the local region of the crack that are significant to the analysis. Bend bar tests provided the experimental simulation of the subject RPV surface crack. This report covers analysis techniques used and presents the findings indicated by the experimental results, for unirradiated material.

34926 (NUREG/CP—0082-Vol.2, pp 325-348) **Dose-rate effects on irradiation embrittlement and composition and temperature effects on annealing/reirradiation sensitivity.** Hawthorne, J.R.; Hiser, A.L. (Materials Engineering Associates, Inc., Lanham, MD). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

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Recent MEA investigations on the effect of neutron flux level on radiation-induced embrittlement accrual and the contributions of metallurgical variables to postirradiation annealing and reirradiation behavior are reviewed. Studies of dose-rate effects involved experiments in the UBR test reactor and separately, radiation sensitivity determinations for the decommissioned Gundremmingen (KRB-A) vessel material. Annealing-reirradiation studies employed 399°C and 454°C heat treatments. Material composition is shown to play a major role in postirradiation annealing recovery. Results illustrate effects of variable copper and variable nickel contents on recovery for steel plate having low phosphorus levels. Composition effects on recovery were also observed for prototypic welds depicting high/low copper and high/low nickel contents and three flux types. The welds, in addition, indicate major differences in re-irradiation sensitivity. The UBR investigations revealed a significant difference in flux level sensitivity between the ASTM A 302-B reference plate and a submerged-arc (S/A) Linde 80 weld, based on C/sub v/ tests and quasi-static fracture toughness (J-R curve) tests. Studies of the Gundremmingen reactor vessel, representing a joint USA-FRG-UK undertaking, revealed an anomaly in strong vs. weak test orientation radiation sensitivity.

34927 (NUREG/CP—0082-Vol.2, pp 349-355) **Radiation embrittlement correlation between power and test reactor data.** Guthrie, G.L. (Hanford Engineering Development Lab., Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A large data base has been examined for evidence of a bias between test reactor and PWR pressure vessel Charpy embrittlement data, where the embrittlement is irradiation induced. The statistical evidence indicates that power reactor embrittlement predictions based on test reactor data will be non-conservative. The existence of the bias is more apparent for weld materials than for plate materials.

34928 (NUREG/CP—0082-Vol.2, pp 357-417) **Progress and results from the Degraded Piping Program - Phase II.** Wilkowski, G.M.; Ahmad, J.; Barnes, C.; Brust, F.; Guerrieri, D.; Kiefner, J.; Kulhowvick, J.; Kramer, G.; Landow, M.; Marschall, C.; Nakagaki, M. (Battelle, Columbus, OH). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

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The NRC Degraded Piping Program - Phase II started at Battelle Columbus Division in March 1984. It is a three year program that calls for intense combined analytical, full-scale pipe fracture experimentation, and material characterization. The global objective is to develop a verified technical basis for leak-before-break analyses and inservice flaw acceptance criteria. In this paper only a few subjects are reviewed. In Section 1.0 there is a general overview of a few technical points discussed. Section 2.0 discusses the development of a plastic-zone screening criteria for determining the load-carrying capacity of circumferentially cracked pipe. Section 3.0 discusses some observations on crack instabilities in carbon steel pipe at 550 F (288 C) and the possibility of them being related to dynamic strain-aging. Section 4.0 discusses predictions of J-R curves with large amounts of crack growth when only small specimen J-R curve data are available. This effort is discussed in greater detail in NUREG/CR-4575, however, some additional weld data are included in this section. The final section summarizes results from analytical round-robins.

34929 (NUREG/CP—0082-Vol.2, pp 419-432) **Piping fracture mechanics data base.** Hiser, A.L. (Materials Engineering Associates, Inc., Lanham, MD). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005805. (CONF-8610135—Vol.2).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A comprehensive, computerized data base of fracture toughness (J-R curve) and other support data from nuclear piping steels has been established. This data base will supply the materials input required for assessments of piping integrity with known or assumed flaw and loading conditions. This data base is for access by NRC personnel, contractors, and other outside users, as required. Regular updates will be made as more data are generated at MEA and by others with close coordination of testing plans tied to other NRC-sponsored research programs.

34930 (NUREG/CP—0082-Vol.3, pp 1-18) **Functionality and leak integrity of containment penetration systems subjected to design basis dynamic loads.** Steele, R. Jr.; Hill, R.C.; Close, J.A. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The results of testing typical US nuclear power plant containment piping penetrations during seismic excitation are presented. Full-sized hardware, including the containment wall penetration, piping, pipe supports, and the isolation valve, were subjected to seismic excitation typical of levels specified in US nuclear power plant designs. The effect of the seismic excitation on valve leakage and operability and the effect on overall system integrity were stud-

ied. All hardware performed well and showed no degradation as a result of the seismic loads.

34931 (NUREG/CP—0082-Vol.3, pp 19-30) **Parameters important to reactor coolant pump seal stability during station blackout.** Hill, R.C.; Rhodes, D.B. (EG & G, Idaho Falls, ID). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An assessment is made of the ability of typical Reactor Coolant Pump (RCP) Shaft Seals to withstand the conditions predicted for a station blackout (loss of all alternating current power) at a nuclear power station. Several factors are identified that are key to seal stability including inlet fluid conditions, pressure downstream of the seal, and geometrical details of the seal rings. Limits for stable seal operation are determined for various combinations of these factors, and the conclusion is drawn that some RCP seals would be near or over the threshold of instability during a station blackout. If the threshold were exceeded, significant leakage of coolant from the primary coolant system could be expected.

34932 (NUREG/CP—0082-Vol.3, pp 31-41) **Dynamic load effects on gate valve operability.** Steele, R. Jr.; MacDonald, P.E.; Arendts, J.G. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

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The Idaho National Engineering Laboratory (INEL) participated in an internationally sponsored seismic research program conducted at the decommissioned Heissdampfreaktor (HDR) located in the Federal Republic of Germany. An existing piping system was modified by installation of an 8-in., naturally aged, motor-operated gate valve from a US nuclear power plant and a piping support system of US design. Six other piping support systems of varying flexibility from stiff to flexible were also installed at various times during the tests. Additional valve loadings included internal hydraulic loads and, during one block of tests, elevated temperature. The operability and integrity of the aged gate valve and the dynamic response of the various piping support systems were measured during 25 representative seismic events.

34933 (NUREG/CP—0082-Vol.3, pp 43-64) **Progress on qualification testing methodology study of electric cables.** Kusama, Y.; Yagi, T.; Okada, S.; Ito, M.; Yoshikawa, M.; Yoshida, K.; Tamura, N.; Kawakami, W. (Japan Atomic Energy Research Institute). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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Five kinds of insulating and jacketing materials such as ethylenepropylene rubber, crosslinked polyethylene, silicone rubber, chlorosulfonated polyethylene and chloroprene used for nuclear power plants were exposed to various sequential LOCA testing environments composed of pre-irradiation and the following steam/spray exposure. Experimental conditions of exposures in the sequential tests were systematically altered in order to estimate the effect of these conditions on mechanical and electrical degradations. Water sorption during the steam/spray exposure was investigated as well. The experimental data show that factors effective to cause mechanical degradation were irradiation dose, dose rate, irradiation atmosphere and steam temperature. Irradiation under oxidative conditions such as at low dose rate, at elevated temperature and in pressurized oxygen caused remarkable electrical degradation and large water sorption during subsequent steam/spray exposure. It can be concluded that degradation under various simultaneous LOCA exposures, in which irradiation and steam/spray are applied simultaneously, even an extreme case of a long term test will be well simulated by applying suitable sequential test conditions such as pre-irradiation under oxidative environments followed by high temperature air-containing steam exposures.

34934 (NUREG/CP—0082-Vol.3, pp 65-76) **General technical requirements for special valves used in nuclear power plants.** Zdarek, J.; Jukl, F. (Sigma Research Institute, Prague, Czechoslovakia). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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The General Requirements for Special Valves Used in Nuclear Power Plants (OTT-82) have been developed for purposes of quality improvement and standardization. Within the scope of OTT-82 fall all types and sizes of special valves used in pipelines and systems of nuclear power plants (NPP) with PWR and RBMK (boiling water cooled, graphite moderated, chanel type) reactors. OTT-82 involves comprehensive design data and requirements for production, inspections, testing, packaging, transportation storage of the valves and manufacturer guarantees.

34935 (NUREG/CP—0082-Vol.3, pp 77-86) **Effectiveness and safety aspects of selected decontamination methods for LWRs.** Duce, S.W.; Simpson, F.B. (EG & G Idaho Inc., Idaho Falls). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

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During the years 1984 and 1985 in-situ chemical decontamination processes were applied extensively in boiling water reactor (BWR) primary coolant recirculation systems (PCRSs) to help facilitate system replacement or inservice inspections, and more limited in pressurized water reactor (PWR) steam generators to facilitate tube plugging or sleeving operations. During these two years four chemical decontamination processes were observed: CAN-DECON, LOMI, DOW NS-1 and PNS CITROX A at a total of nine different facilities, seven BWRs and two PWRs. These chemical decontaminations were performed to reduce the man-rem that would be received by the work force to perform the specified task(s). This paper presents information and results on (a) base metal attack during the process application, (b) methods used to protect critical components, (c) activity removed, (d) man-rem savings, and (e) waste forms and volumes.

34936 (NUREG/CP—0082-Vol.3, pp 87-106) **Probability of failure in BWR reactor coolant piping.** Holman, G.: Chou, C.K. (Lawrence Livermore National Lab., CA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Lawrence Livermore National Laboratory (LLNL) has estimated the probability of double-ended guillotine break (DEGB) in the reactor coolant piping of Mark I boiling water reactor (BWR) plants. Two causes of pipe break are considered: crack growth at welded joints and the seismically-induced failure of component supports. For the former a probabilistic fracture mechanics model is used, for the latter a probabilistic support reliability model. To account for effects of intergranular stress corrosion cracking (IGSCC), a probabilistic model was developed based on experimental and field data compiled from several sources. Times to crack initiation and crack growth rates for Types 304 and 316NG stainless steel are correlated to material-specific damage parameters which consolidate the separate effects of coolant environment (temperature, dissolved oxygen content, level of impurities), stress (including residual stress), and degree of sensitization. Results to date show IGSCC clearly dominates the probability of failure in 304SS recirculation piping, mainly due to cracks that initiate within a few years after plant operation has begun. Replacing Type 304 piping with 316NG reduces failure probabilities by several orders of magnitude.

34937 (NUREG/CP—0082-Vol.3, pp 107-119) **SSI and structural benchmarks.** Philippacopoulos, A.J.; Miller, C.A.; Costantino, C.J.; Graves, H. Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper presents the latest results of the ongoing program entitled, Standard Problems for Structural Computer Codes, currently being worked on at BNL for the USNRC, Office of Nuclear Regulatory Research. During FY 1986, efforts were focussed on three tasks, namely, (1) an investigation of ground water effects on the response of Category I structures, (2) the Soil-Structure Interaction Workshop and (3) studies on structural benchmarks associated with Category I structures. The objective of the studies on ground water effects is to verify the applicability and the limitations of the SSI methods currently used by the industry in performing seismic evaluations of nuclear plants which are located at sites with high water tables. In a previous study by BNL (NUREG/CR-4588), it has been concluded that the pore water can influence significantly the soil-structure interaction process. This result, however, is based on the assumption of fully saturated soil profiles. Consequently, the work was further extended to include cases associated with variable water table depths. In this paper, results related to cut-off depths beyond which the pore water effects can be ignored in seismic calculations, are addressed. Comprehensive numerical data are given for soil configurations typical to those encountered in nuclear plant sites. These data were generated by using a modified version of the SLAM code which is capable of handling problems related to the dynamic response of saturated soils. Further, the paper presents some key aspects of the Soil-Structure Interaction Workshop (NUREG/CP-0054) which was held in Bethesda, MD on June 1, 1986. Finally, recent efforts related to the task on the structural benchmarks are described.

34938 (NUREG/CP—0082-Vol.3, pp 121-145) **NRC valve performance test program - check valve testing.** Jeanmougin, N.M. (Energy Technology Engineering Center, Canoga Park, CA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

The Valve Performance Test Program addresses the current requirements for testing of pressure isolation valves (PIVs) in light water reactors. Leak rate monitoring is the current method used by operating commercial power plants to survey the condition of their PIVs. ETEC testing of three check valves (4-inch, 6-inch, and 12-inch nominal diameters) indicates that leak rate testing is not a reliable method for detecting impending valve failure. Acoustic emission monitoring of check valves shows promise as a method of detecting loosened internals damage. Future efforts will focus on evaluation of acoustic emission monitoring as a technique for determining check valve condition. Three gate valves also will be tested to evaluate whether the check valve results are applicable to gate type PIVs.

34939 (NUREG/CP—0082-Vol.3, pp 147-152) **Piping and fitting dynamic reliability program.** Guzy, D. Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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The NRC and EPRI are cooperating jointly in the Piping and Fitting Reliability Research Program. The objectives of this program are: to identify failure mechanism and failure levels of piping components and systems under dynamic loadings; to provide a data base that will improve the prediction of piping system response and failure due to high level dynamic loads; and to develop an improved, realistic and defensible set of piping design rules for inclusion into the ASME Code. The joint EPRI/NRC program began in the Spring of 1985, and will take approximately 3 years to complete. The EPRI/NRC program outlined above is directed primarily at evaluating and improving the piping design rules in Section III of the ASME Code. ASME and NRC Piping Review Committee activities related to support and nozzle design will play a role in the acceptance of the future piping design rules.

34940 (NUREG/CP—0082-Vol.3, pp 153-177) **Six-inch-diameter pipe seismic fragility test.** Chen, W.P.; DeVita, V.; Onesto, A.T. (Energy Technology Engineering Center, Canoga Park, CA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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This paper contains the test results and assessments of seismic fragility tests performed on a 6-in.-diameter piping system. The objective of the test was to investigate the ability of a piping system to withstand high level dynamic seismic and other loadings. The test was performed in the ETEC Seismic Fragility Test Facility. Levels of loadings achieved during seismic testing were 20 to 30 times larger than usually specified for Safe Shutdown Earthquakes of contemporary nuclear power plants. Based on failure data obtained during seismic and other dynamic testing, it was concluded that nuclear piping systems are inherently stronger to resist dynamic seismic loadings than currently permitted by design criteria in existing codes and standards or would be predicted by the probabilistic risk assessment and several proposed nonlinear methods of failure analysis.

34941 (NUREG/CP—0082-Vol.3, pp 179-197) **Pipe damping studies.** Ware, A.G. (EG & G Idaho, Inc., Idaho Falls). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

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The Idaho National Engineering Laboratory (INEL) is conducting a research program to assist the United States Nuclear Regulatory Commission in determining best-estimate damping values for use in the dynamic analysis of nuclear power plant piping systems. This paper describes four tasks in the program that were undertaken in FY-86. In the first task, tests were conducted on a 5-in. INEL laboratory piping system and data were analyzed from a 6-in. laboratory system at the ANCO Engineers facility to investigate the parameters influencing damping in the seismic frequency range. Further tests were conducted on 3- and 5-in. INEL laboratory piping systems as the second task to determine damping values representative of vibrations in the 33 to 100 Hz range, typical of hydrodynamic transients. In the third task a statistical evaluation of the available damping data was conducted to determine probability distributions suitable for use in probabilistic risk assessments, and the final task evaluated damping data at high strain levels.

34942 (NUREG/CP—0082-Vol.3, pp 199-217) **Nonlinear piping damping and response predictions.** Severud, L.K.; Weiner, E.O.; Lindquist, M.R.; Anderson, M.J.; Wagner, S.E. (Westinghouse Hanford Co., Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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The high level dynamic testing of four prototypic piping systems, used to provide benchmarks for analytical prediction comparisons, is overviewed. The size of pipe tested ranged from one-inch to six-inches in diameter and consisted of carbon steel or stainless steel material. Failure of the tested systems included progressive gross deformation or some combination of ratchetting-fatigue. Pretest failure predictions and post test comparisons using simplified elastic and elasto-plastic methods are presented. Detailed nonlinear inelastic analyses are also shown, along with a typical ratchet-fatigue failure calculation. A simplified method for calculating modal equivalent viscous damping for snubbers and plastic hinges is also described. Conclusions are made regarding the applicability of the various analytical failure predictive methods and recommendations are made for future analytic and test efforts.

34943 (NUREG/CP—0082-Vol.3, pp 219-227) **Examples of NRC research products used in regulation.** Anderson, N.R. (Office of Nuclear Reactor Regulation, Washington, DC). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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The key to effective research is a close relationship between information needs and research results. This can only be achieved by close cooperation between the researchers and the regulators. At the NRC, this relationship has matured over the years until now

the researchers participate in definition of the information needs and the regulators help define the research programs. The more formal means of ensuring a close match between needs and results include joint research groups, oversight working groups, and a system of Research Information Letters (RILs). On an informal basis there are many day to day discussions and meetings on the various programs which ensure effective program guidance and early identification of significant findings. This paper describes both the formal and informal researcher/regulation interface and discusses some examples of how specific research programs are utilized in the regulatory process. Specific programs described are the pressurized thermal shock program, the seismic margins program and the Category 1 structures program. Other examples cited are the aging and life extension programs.

34944 (NUREG/CP—0082-Vol.3, pp 229-254) **Component fragility research program: prioritization and demonstration testing.** Holman, G.S.; Chou, C.K. (Lawrence Livermore National Lab., CA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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Current probabilistic risk assessment (PRA) methods for nuclear power plants utilize seismic fragilities - probabilities of failure conditioned on the severity of seismic input motion - which are based largely on limited test data and on engineering judgement. As part of the NRC Component Fragility Research Program (CFRP), the Lawrence Livermore National Laboratory (LLNL) developed procedures for fragilities testing. These procedures were applied to evaluate actual seismic capacities of motor control center (MCC) electrical devices, to develop seismic fragility curves suitable for PRA application, and to suggest various methods of improving MCC seismic performance. In other CFRP activities, LLNL used high-level qualification data to develop fragility descriptions for selected equipment, and identified candidate components for future comprehensive fragilities testing using similar procedures.

34945 (NUREG/CP—0082-Vol.3, pp 255-259) **Synthesizing seismic fragility of components by use of existing data.** Bandyopadhyay, K.K; Hofmayer, C.H. Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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Brookhaven National Laboratory has completed Phase I of the Component Fragility Program and is now performing Phase II. The results of Phase I have been published in NUREG/CR-4659. In both Phases, existing test data for various models are utilized to determine the seismic fragilities of different equipment categories. This represents the first large scale attempt to assemble, compile and interpret the very large heretofore fragmented data base. In Phase I, a methodology has been established to compile the test data for variations of testing methods, vibration inputs, damping values, etc. Test response spectra have been used as a measure of the test vibration inputs. Fragility data have been collected and stored in a computerized data bank at BNL for many electrical and control equipment pieces. The data for motor control centers (MCC) and switchgears have been analyzed in Phase I for determination of the respective fragility levels. Additional test data are being collected in Phase II for these two equipment pieces, as well as other equipment categories. Statistical analyses are also being performed to estimate a single fragility descriptor for each equipment family.

34946 (NUREG/CP—0082-Vol.3, pp 261-275) **Seismic margins review of nuclear power plants: program overview and status.** Murray, R.C.; Prassinos, P.G.; Cummings, G.E. (Lawrence Livermore National Lab., CA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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In 1984, the Nuclear Regulatory Commission (NRC) initiated the Seismic Margins Program (SMP) because of regulatory needs and a changing perception of the seismic hazard. The NRC formed the Expert Panel on the Quantification of Seismic Margins and charged them to work closely with an in-house NRC staff Working group on Seismic Margins to provide technical guidance on the assessment of seismic margins. The overall goal of the SMP is the development of a methodology and guidelines that can be readily used by the NRC and industry for assessing the inherent quantitative seismic capacity of nuclear power plants. The development of a soundly based and effective method for the assessment of how much margin actually exists in important components, systems and the plant will serve to minimize the need for changing regulatory requirements and licensing actions as the estimates of seismic hazards change. In addition, a seismic margins assessment can provide a basis for confidence in the capacity of nuclear power plants and can be applied when questions arise about the seismic capacity. The purpose of this paper is to provide an overview and current status of the Seismic Margin Program.

34947 (NUREG/CP—0082-Vol.3, pp 277-293) **Validation of seismic soil-structure interaction analysis methods.** Kot, C.A.; Srinivasan, M.G.; Hsieh, B.J.; Tang, Y.K.; Kassawara, R.P. (Argonne National Lab., IL). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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The cooperative program between NRC/ANL and EPRI for the validation of soil-structure interaction analysis methods with actual seismic response data is described. A large-scale model of a containment building has been built by EPRI/Taipower in a highly seismic region of Taiwan. Vibration tests were performed, first on the basemat before the superstructure was built and then on the completed structure. Since its completion, the structure has experienced many earthquakes. The site and structural response to these earthquakes have been recorded with field (surface and downhole) and structure instrumentation. The validation program involves blind predictions of site and structural response during vibration tests and a selected seismic event, and subsequent comparison of the predictions and measurements. The predictive calculations are in progress. The results of the correlation are expected to lead to an evaluation of the methods as to the conservatisms and sensitivities.

34948 (NUREG/CP—0082-Vol.3, pp 295-312) **HDR Phase II vibrational experiments.** Malcher, L.; Kot, C.A. (Kernforschungszentrum Karlsruhe, Germany, F.R.). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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As part of the second phase of vibrational/earthquake investigations at the HDR (Heissdampfreaktor) Test Facility in Kahl/Main, FRG, high-level shaker tests (SHAG) were performed during June and July 1986. The purpose of these experiments was to investigate full-scale structural response, soil/structure interaction, and piping and equipment response under strong excitation conditions. While global safety considerations imposed load limitations, the HDR soil/structure system was nevertheless tested to its capacity limits. The performance of pipe support systems in as many as seven different multiple support pipe hanger configurations, ranging from flexible to stiff systems, was evaluated in the tests. Data obtained in the tests will be used to validate analysis methods.

34949 (NUREG/CP—0082-Vol.3, pp 313-334) **Seismic category I structures program.** Bennett, J.G.; Farrar, C.R.; Dunwoody, W.E. (Los Alamos National Lab., NM). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

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The Seismic Category I Structures Program entered a new phase at the end of FY 1984. During the prior fiscal years, tests on microconcrete scale model shear deformation dominated structures were completed. The results indicated that these structures responded to seismic excitations with frequencies that were reduced by factors of two or more over those calculated based on an uncracked cross section strength-of-materials approach. This reduction implies that stiffness associated with seismic working loads

(loads resulting from an operating basis earthquake up to and including a safe shutdown earthquake) are down by a factor of four or more. These reductions were also consistent with those measured during quasistatic tests to an equivalent level of loading. Furthermore, though the structures themselves were shown to have sufficient reserve margin, the equipment and piping are designed to response spectra that are based on uncracked cross sectional member properties, and these spectra may not be appropriate for actual building responses. The new phase of the program was aimed at verification of these conclusions using real concrete structures. These test structures were designed based on guidance from the program's Technical Review Group (TRG), a group of nationally recognized nuclear civil structure experts. During FY 86, a large TRG type structure (f4-inch walls of real concrete, No. 3 rebar, and with about 15 tons of added mass) was tested seismically at the construction Engineering Research Laboratory (CERL) in Champaign, IL. Results are presented.

34950 (NUREG/CP—0082-Vol.3, pp 335-350) **Risk evaluations of aging phenomena: the linear aging reliability model and its extensions.** Vesely, W.E. (Science Applications International Corp., Columbus, OH). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

A model for component failure rates due to aging mechanisms has been developed from basic phenomenological considerations. In the treatment, the occurrences of deterioration are modeled as following a Poisson process. The severity of damage is allowed to have any distribution, however the damage is assumed to accumulate independently. Finally, the failure rate is modeled as being proportional to the accumulated damage. Using this treatment, the linear aging failure rate model is obtained. The applicability of the linear aging model to various mechanisms is discussed. The model can be extended to cover nonlinear and dependent aging phenomena. The implementability of the linear aging model is demonstrated by applying it to the aging data collected in NRC's Nuclear Plant Aging Research (NPAR) Program. The applications show that aging as observed in collected data have significant effects on the component failure probability and component reliability when aging is not effectively detected and controlled by testing and maintenance.

34951 (NUREG/CP—0082-Vol.3, pp 351-367) **Interim assessment of reactor protection system aging.** Jacobs, P.T. (Idaho National Engineering Lab., Idaho Falls). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3). Contract AC07-76ID01570.

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

An interim assessment of reactor protection system aging is presented. The research approach is a Phase I study for the Nuclear Plant Aging Research Program of the United States Nuclear Regulatory Commission. Results addressing each of the program's technical objectives are presented. Plans for continuation of the work into Phase II are discussed.

34952 (NUREG/CP—0082-Vol.3, pp 369-387) **Overview of recent operating experience regarding plant aging.** Caruso, M.A.; Holahan, G.M. (Nuclear Regulatory Commission, Washington, DC). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

In order to better understand all the factors which contribute to high reactor scram frequencies in new operating nuclear power plants, the authors have made a comparison of the frequency in early life between plants which went into operation in the 1960's and early 1970's and those which have gone into operation in the past four years. Scram frequency per unit operating time for the two plant groups is calculated and compared to see the extent to which design differences (e.g., capacity, thermal margin) affect scram frequency. In addition to this analysis a discussion of several recent operating reactor events involving age-related component failures is provided.

34953 (NUREG/CP—0082-Vol.3, pp 389-402) **Application of diagnostics to determine motor operated valve operational readiness.** Eissenberg, D.M. Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

ORNL has been carrying out an aging assessment of motor-operated valves (MOVs) with the primary objective of recommending diagnostic methods for detecting and trending aging. As a result of experimental investigations at ORNL, it was discovered that the motor current during a valve stroke was a very useful diagnostic parameter for detecting and trending many MOV drive train load variations. The motor current signatures were analyzed at four levels: mean value for a stroke, gross trends during a stroke, transients, and noise frequency spectra. Examples illustrating the use of this technique are presented. The use of motor current signature analysis was also shown to apply to other electric motor driven equipment. Future work includes developing a data base of MOV diagnostics, including criteria for determining the extent of degradation and application of the technique to other LWR motor driven safety equipment.

34954 (NUREG/CP—0082-Vol.3, pp 403-417) **Interactive effects of relay and circuit breaker aging in a safety-related system.** Toman, G.J.; Bacanskas, V.P.; Shook, T.A.; Ladlow, C.C.; Gunther, W. Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper provides an overview of the results of a program to evaluate the aging of circuit breakers and relays and the effects of that aging on the function of a safety system used in nuclear power plants. The program was performed under the Nuclear Plant Aging Research (NPAR) Program of the US Nuclear Regulatory Commission under subcontract to Brookhaven National Laboratory. There were two primary aspects to the program. In the first, the aging and failure modes of relays and circuit breakers were determined by evaluating the construction, design, and materials and the failure data related to nuclear power plant service. In the second, the interactions between a safety system and its relays and circuit breakers were evaluated to determine the effects of relay and circuit breaker aging on the function of the safety system. The aging of relays and circuit breakers was assessed through evaluation of failure data bases, discussions with utility personnel, and evaluation of equipment operating and maintenance manuals. The interaction study was based on an analysis of the safety injection system of a pressurized water reactor. The effects of stresses from the system were analyzed for the tendency to cause deterioration of the relays and circuit breakers in the system. Then the effect of the deterioration of relays and circuit breakers on the functional capability of the safety system was evaluated.

34955 (NUREG/CP—0082-Vol.3, pp 419-424) **Nuclear service emergency diesel generator aging research.** Hoopingarner, K.R.; Vause, J.W. III; Dingee, D.A. (Battelle, Pacific Northwest Lab., Richland, WA). Feb 1987. NTIS, PC A19/MF A01 - GPO. File Number TI87005959. (CONF-8610135—Vol.3).

From 14. water reactor safety information meeting; Gaithersburg, MD, USA (27 Oct 1986).

This paper reports the progress of diesel-generator aging research currently underway at Pacific Northwest Laboratory (PNL). Nuclear service diesel generators have been selected to be studied as a part of the Nuclear Plant Aging Research (NPAR) Program by the Nuclear Regulatory Commission's Office of Nuclear Regulatory Research, Division of Engineering Safety. Equipment aging can potentially reduce the capability of a nuclear plant to operate safely. This program is intended to identify, evaluate and recommend ways to mitigate aging. The preliminary results of this research program, using a statistical technique based upon expert analysis, shows that diesel-generator aging can be detected, and quantified. The results are positive in that the components that fail, how they fail and what measures for correction have been used have all been analyzed and reported. The chief results of this first

study phase are presented in this paper. The analysis shows that the aging of diesel generators is related most often to a few major components and engine systems and that these can be repaired or replaced to maintain the emergency power function. Further the study indicated that the percentage of aging related failures increases with plant age and that certain practices and maintenance/surveillance methods have the potential to mitigate safety concerns.

34956 **(NUREG/CR—4330-Vol.3) Review of light water reactor regulatory requirements: Assessment of selected regulatory requirements that may have marginal importance to risk: Postaccident sampling system, Turbine missiles, Combustible gas control, Charcoal filters.** Scott, W.B.; Jamison, J.D.; Stoetzel, G.A.; Tabatabai, A.S.; Vo, T.V. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). May 1987. Contract AC06-76RL01830. 131p. (PNL—5809-Vol.3). NTIS, PC A07/MF A01 - GPO. File Number TI87009815.

In a study commissioned by the Nuclear Regulatory Commission (NRC), Pacific Northwest Laboratory (PNL) evaluated the costs and benefits of modifying regulatory requirements in the areas of the postaccident sampling system, turbine rotor design reviews and inspections, combustible gas control for inerted Boiling Water Reactor (BWR) containments, and impregnated charcoal filters in certain plant ventilation systems. The basic framework for the analyses was that presented in the Regulatory Analysis Guidelines (NUREG/BR-0058) and in the Handbook for Value-Impact Assessment (NUREG/CR-3568). The effects of selected modifications to regulations were evaluated in terms of such factors as public risk and costs to industry and NRC. The results indicate that potential modifications of the regulatory requirements in three of the four areas would have little impact on public risk. In the fourth area, impregnated charcoal filters in building ventilation systems do appear to limit risks to the public and plant staff. Revisions in the severe accident source term assumptions, however, may reduce the theoretical value of charcoal filters. The cost analysis indicated that substantial savings in operating costs may be realized by changing the interval of turbine rotor inspections. Small to moderate operating cost savings may be realized through postulated modifications to the postaccident sampling system requirements and to the requirements for combustible gas control in inerted BWR containments. Finally, the use of impregnated charcoal filters in ventilation systems appears to be the most cost-effective method of reducing radioiodine concentrations.

34957 **(NUREG/CR—4700-Vol.4) Containment event analysis for postulated severe accidents: Grand Gulf Nuclear Station, Unit 1.** Amos, C.N.; Kolaczkowski, A.M. (Sandia National Labs., Albuquerque, NM (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Apr 1987. Contract AC04-76DP00789. 448p. (SAND—86-1135-Vol.4). NTIS, PC A19/MF AO1 - GPO. File Number TI87010288.

A study has been performed as part of the Severe Accident Risk Reduction Program (SARRP) to investigate the response of a particular boiling water reactor with a Mark III containment (Grand Gulf Unit 1) to postulated severe accidents. A detailed containment event tree for the Grand Gulf Plant has been developed to describe the various possible accident pathways that can lead to radioactive releases from containment. Data and analyses from a large number of NRC and industry-sponsored programs have been reviewed and used as a basis for quantifying the event tree, i.e., determining the likelihood of the pathways at each branch point for a variety of accident sequence initiators. A generalized containment event tree code, called EVNTRE, has been developed to facilitate the quantification. The uncertainty in the results has been examined by performing the quantification three times, using a different set of input each time to represent the variation of opinion in the reactor safety community.

34958 **(NUREG/CR—4883) Review of research on uncertainties in estimates of source terms from severe accidents in nuclear power plants.** Kouts, H. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research). Apr 1987. Contract AC02-76CH00016. 100p. (BNL-NUREG—52061). NTIS, PC A05/MF A01 - GPO. File Number TI87010088.

A review has been undertaken by four panels of experts, of the sources of uncertainty in source terms from accidents to nuclear power plants as presented by the document NUREG-0956. These panels contained eminent scientists from the United States, the United Kingdom, and the Federal Republic of Germany. Separate reports by the panels provide detailed discussions and conclusions regarding the uncertainties and the NRC research programs for their resolution. An overall summary of the results of panel deliberation is also given.

34959 **(NUREG/CR—4885) Seismic hazard characterization of the eastern United States: Comparative evaluation of the LLNL and EPRI studies.** Bernreuter, D.L.; Savy, J.B.; Mensing, R.W. (Lawrence Livermore National Lab., CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering and System Technology). May 1987. Contract W-7405-ENG-48. 288p. (UCID—20696). NTIS, PC A13/MF A01 - GPO. File Number TI87010803.

In 1982, the Lawrence Livermore National Laboratory (LLNL developed a methodology to characterize the seismic hazard for all sites of the eastern United States (EUS) east of the Rocky Mountains. The utility sponsored Electric Power Research Institute (EPRI) followed suit in late 1983 with a similar study. The purpose of this study was to help in understanding the reasons for differences in results between the LLNL and the EPRI study. We first investigated possible differences in the theories and assumptions used to develop the hazard models and concluded that all inputs being equal, the two methods were essentially equivalent. Then we analyzed the various input parameters, their values and the way they were collected. And finally we performed some sensitivity analyses, in particular with the seismicity parameters, the ground motion models and the value of the lower bound magnitude of integration (m/sub o/), to estimate the importance and evaluate the relative contributions to the total differences between the two studies. The three main differences were found to be: (1) the value of m/sub o/, (2) the ground motion models, and (3) the fact that LLNL accounted for a local site correction and EPRI did not.

34960 **(NUREG/CR—4903-Vol.1) Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Direct empirical scaling of response spectral amplitudes from various site and earthquake parameters.** Lee, V.W.; Trifunac, M.D. (Structural and Earthquake Engineering Consultants, Inc., Arcadia, CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. 341p. NTIS, PC A15/MF A01 - GPO. File Number TI87900766.

Separate abstracts were prepared for the individual papers in this report.

34961 **(NUREG/CR—4903-Vol.2) Selection of earthquake resistant design criteria for nuclear power plants: Methodology and technical cases: Methods for introduction of geological data into characterization of active faults and seismicity and upgrading of the uniform risk spectrum technique.** Anderson, J.G.; Lee, V.W.; Trifunac, M.D. (Structural and Earthquake Engineering Consultants, Inc., Arcadia, CA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering). May 1987. 196p. NTIS, PC A09/MF A01 - GPO. File Number TI87900767.

Separate abstracts were prepared for the individual papers in this report.

34962 (SIS—1986:5-Rev.) Cesium fallout in Norway after the Chernobyl accident. Backe, S.; Bjerke, H.; Rudjord, A.L.; Ugletveit, F. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 51p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. File Number DE87780146.

Results of country-wide measurements of /sup 137/Cs and /sup 134/ Cs in soil samples in Norway after the Chernobyl accident are reported. The results clearly demonstrates that municipalities in the central part of southern Norway, Troendelag and the southern part of Nordland, have been rather heavily contaminated. The total fallout of /sup 137/Cs and /sup 134/Cs from the Chernobyl accident in Norway is estimated to 2300 TBq and 1200 TBq, respectively. This is approximately 6% of the cesium activity released from the reactor.

34963 Boiling water neutronic reactor incorporating a process inherent safety design. Forsberg, C.W. (to Dept. of Energy, Washington, DC). US Patent 4,666,654. 19 May 1987. Filed date 19 Feb 1985. vp.

This patent describes a boiling-water nuclear reactor incorporating an inherent safety design comprising: a boiling-water reactor core; an elongated, vertically-oriented, generally cylindrical, prestressed concrete reactor vessel having upper and lower ends. The reactor core is positioned within the reactor vessel near the lower end thereof; a first volume of clean reactor coolant water which circulates through the reactor core during normal reactor operation; a second volume of cool borated water which is separated from the first volume of reactor coolant during normal operation of the reactor. The first and second volumes of water extend coaxially along substantially the entire vertical length of the reactor vessel; upper and lower interface zones, wherein the first and second volumes of water are maintained in non-mixing contact during normal reactor operation, located near the upper and lower ends of the reactor vessel.

34964 Leakage potential of LWR containment penetrations under severe accident conditions. Koenig, L.N.; Subramanian, C.V. (Sandia National Labs., Albuquerque, NM). *Nuclear Engineering and Design;* **100**: No. 2, 121-128(Mar 1987). (CONF-850821—).

From International seminar on containment of nuclear reactors; Brussels, Belgium (26 Aug 1985).

This paper is an overview of a study of the performance of mechanical penetrations in light-water reactor (LWR) containment buildings that are subjected to severe accident environments. The study is concerned with modes of failure as well as the magnitude of leakage. The following tests have been completed, are under way, or are planned: (a) seals and gaskets have been tested to register the effects of radiation aging, thermal aging, seal geometry, and squeeze on seal and gasket materials in severe accident environments; (b) the performance of a full-scale airlock will be evaluated at severe accident temperature and pressure levels; (c) personnel airlock and equipment hatch tests were made on a 1/8-scale model of a steel containment building; and (d) tests of mechanical penetrations are planned as part of a test on a 1/6-scale model of a reinforced concrete building. This program is part of an overall USNRC effort to evaluate the integrity of LWR containment buildings.

34965 Insights into the behavior of LWR steel containment buildings during severe accidents. Clauss, D.B.; Horschel, D.S.; Blejwas, T.E. (Sandia National Labs., Albuquerque, NM). *Nuclear Engineering and Design;* **100**: No. 2, 189-204(Mar 1987). (CONF-850821—).

From International seminar on containment of nuclear reactors; Brussels, Belgium (26 Aug 1985).

Investigations into the performance of steel containment subject to pressure and temperature greater than their design basis loads are discussed. The timing, mechanism, and location of a containment failure, i.e., release of radioactive materials, have an important impact on the consequences of a severe accident. We review the results of experiments on steel containment models pressurized to failure, on aged and unaged seals subjected to elevated temperature and pressure, and on electrical penetration assemblies tested for leakage. Based on the results, the important features and details of analytical methods that can be used to predict containment performance are identified. Finally, we speculate on the performance of steel containments in severe accident conditions.

34966 Reflections on Chernobyl. Weinberg, A.M. (Institute for Energy Analysis, Oak Ridge Associated Universities, Oak Ridge, TN). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 1, 18-21(Oct 1986).

The Chernobyl and Three Mile Island reactor accidents are revealing some of the social costs of such failures, widespread opposition to nuclear power. As far as mortality and morbidity go, Chernobyl was probably a smaller incident than the chemical disaster at Bhopal. But nuclear people must accept the idea that a nuclear hazard is perceived as somehow different. Since nuclear energy will be needed to replace oil eventually, and the environmental impacts of properly operating nuclear power plants are far less than those of fossil fuelled power plants, this appears to be an appropriate time for the United States and other interested countries to start developing inherently safe nuclear power plants which will be acceptable to the public.

34967 Off-site protective action selection for nuclear reactor accidents. Weerakkody, S.D. University Park, PA; Pennsylvania State Univ. (1986). 198p. University Microfilms Order No. 87-05,431.

Thesis (Ph. D).

A computer program based upon a model using a rational theoretical basis was developed to select appropriate off-site protective actions during nuclear reactor accidents. The special features of this program include (a) introduction of a precursor concept that uses the history of the accident progression to determine the spectrum of potential accident scenarios and estimates of the likelihoods of each accident scenario; (b) use of statistical decision theory and the concept of entropy of a spectrum to select the appropriate protective actions using either the minimax principle or the Bayes action method; and (c) introduction of methods to quantify evacuation travel risks. In order to illustrate the usefulness of the computer program, it was applied at three stages of the Three Mile Island accident scenario. Quantified non-radiological risks of evaluation have been used to establish dose thresholds below which evacuations are not justified. Using the Poisson analysis for evacuation risks and the absolute L-L BEIR model for radiation risk suggests 330 mrems as a reasonable value for this threshold. The usefulness of the program in developing a technical basis to select the size of the plume exposure pathway emergency planning zone (EPZ) is discussed. Quantified evacuation risks, cost, and the current rationale upon which the EPZ is based, justify an EPZ between 5-10 miles for WASH-1400 source-terms.

25 ENERGY STORAGE

2501 Magnetic

REFER ALSO TO CITATION(S) 34819

2509 Batteries

REFER ALSO TO CITATION(S) 35041

34968 (AD-A—178844/7/XAB) Development of nickel oxide/hydrogen multilayer bipolar battery for pulsed power. Report for 1 September 1986-28 February 1987. (EIC Labs., Inc., Norwood, MA (USA)). 24 Mar 1987. 38p. NTIS, PC A03/MF A01.

This program is concerned with the development of a nickel oxide/hydrogen battery for pulsed power applications. It is based on thin-film nickel oxide cathodes and metal hydride (lanthanum-nickel (5)) anodes. Thin-film nickel oxides were prepared by reactive RF sputtering, chemical vapor deposition, anodic oxidation of nickel and by cathodic precipitation of nickel hydroxide. Thin $LaNi_5$ films were prepared by rf sputtering from target of the same composition. Sputtered films showed much more irreversible electrochemical behavior than vapor deposited and anodically formed nickel oxides. Initial nickel oxide pulse currents were several hun-

dred mA/sq. cm. Only a fraction of the electrode capacity was accessible at short times <10 msec. The $LaNi_5$ electrodes were electrochemically reversible for the hydrogen storage reaction, and pulse currents of thin film LaNi5H(x) electrodes were of the same magnitude as the non-sputtered NiOx. Rates appear limited by surface reaction kinetics and by bulk diffusion.

34969 **(DOE/ER/10191—T1) All inorganic ambient temperature rechargeable lithium battery: Final report, November 1980 to June 30, 1985.** Kuo, H.C.; Dey, A.N.; Schlaikjer, C.; Foster, D.; Kallianidis, M. (Duracell, Inc., Needham, MA (USA). Duracell Research Center). [1987]. Contract AC01-80ER10191. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87005020.

Research and development was carried out on ambient-temperature rechargeable lithium batteries with inorganic SO_2 electrolytes. The following solutes in SO_2 were studied: tetrachloroaluminates, $LiAlCl_4$, $Li_2B_{10}Cl_{10}$, $LiGaCl_4$, etc. $CuCl_2$ was used as one of the electrode materials. (DLC)

34970 **(PB—87-180980/XAB) Organometallic for lithium intercalation. Final report.** Yuan, S.S.; Walsh, F. (Tracer Technologies, Inc., Newton, MA (USA)). 15 Aug 1984. 35p. NTIS, PC A03/MF A01.

The goal of the Phase I program was to determine whether pairs of electrodes containing tetraazaannulenes (TAAs) can be used as the anode and cathode in a lithium metal-free lithium secondary cell. The extent of chemical and electrochemical lithium intercalation of selected TAAs was evaluated. Cyclic voltammetry was also used to characterize the lithiation reaction involved. Three TAAs were identified as electrochemically intercalating lithium with up to five equivalents incorporated. Cells with pairs of electrodes containing TAAs capable of lithium intercalations were cycled; open circuit voltages of such cells were as high as 1.5 V.

34971 **Experimental and modeling studies of the sulfur electrode in the sodium/sulfur cell.** Naftel, S.A.; Mc Larnon, F.R.; Cairns, E.J. (Applied Science Div., Lawrence Berkeley Lab., and Dept. of Chemical Engineering, Univ. of California, Berkeley, CA 94720). pp 08.31(1)-08.31(2) of Proceedings of the International Society of Electrochemistry 37th meeting (Extended abstracts). Graz, Austria; International Society of Electrochemistry (1986). (CONF-8608152—).

From 37. meeting of the International Society of Electrochemistry; Vilnius, USSR (1 Aug 1986).

Since 1967, a large amount of effort has been expended in the development of a practical Na/S battery. Much less effort has been devoted to understanding of the physicochemcal processes occurring during the operation of the sulfur electrode. Mathematical modeling efforts have been restricted to forms too simple to account for convective flow, preferential wetting and flow through the porous medium. In addition, these models have been incapable of relating these phenomena to fundamental physical data, such as diffusion coefficients, density, viscosity and permeability. The objectives of this work are as follows: (1) to develop a two-dimensional model of the sulfur electrode in Na/S cells, and (2) to collect data on the distribution of potential within the electrode. This effort is expected to permit determination of active-material distribution, as well as current and potential distributions in the sulfur electrode, thereby enhancing understanding of the processes occurring during cell charge/discharge, and providing direction to efforts to improve cell behavior.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 34545, 34546, 34718, 35015

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 34546, 34547, 34562, 34681, 34822, 34966, 34985, 34998, 34999, 35015, 35050

34972 **(EPRI-EM—5108) Industrial interfuel substitution: Model development and case study: Final report.** Tabors, R.; Russo, G.; White, D.; Lee, T.; Fromme, J.W.; Klumpar, I.; Aperjis, D.; Batey, G.; Gevelber, M. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.; Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 276p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920450.

A set of tools were developed for evaluation of the potential for industrial interfuel substitution, most specifically in boiler fuels between oil, coal, and gas. A new approach to the evaluation of regional interfuels analysis has been developed which builds upon detailed, plant-specific energy economic analyses; these are then aggregated to the industry and finally to the regional level. Existing tools are used in new ways which allow decision makers both in industry and government to evaluate better specific strategic fuels options. The tools developed in are planning/analysis models of fuel use including, significantly, cogeneration. They also include economic/financial models at the plant level as well as a set of data bases for combustion and cogeneration technologies. Finally, as was indicated above, a framework for industry aggregation has been developed. Regional impacts are evaluated using an EPA approved air quality modeling structure modified for this effort and regional and transport impacts can be evaluated for the region given knowledge of fuel demands. Each of these components is discussed in greater detail in the main report and its appendices.

34973 (NP—7752440, pp 38-50) **Research results of the Energy Physics Section at the Institute of Theoretical Physics, Technical University of Graz.** Heindler, M. (Technische Univ., Graz, Austria. Arbeitsgruppe fuer Energiephysik). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

A report by the Energy Physics Section at the Institute for Theoretical Physics of the University of Graz as to the points of main effort in research and systems analyses of energy systems as well as to the development of an evaluation methodology.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 34515, 34621, 34622, 34624, 34627, 34631, 34636, 34714, 34731, 34986, 34991, 35059, 35586, 35680, 35683, 35684, 35707, 35708, 35709, 35727, 35730, 35732, 35746, 35747, 35748, 35749, 35760, 35761, 35780, 35803, 35804

34974 **(AD-A—179054/2/XAB) Tactile feedback for teleoperator systems. Final report for period ending August 1985.** Vercruyssen, M. (SEACO, Inc., Kailue, HI (USA)). Nov 1986. 18p. NTIS, PC A02/MF A01.

Teleoperators or telerobots are semi-intelligent remote-controlled operators that perform a variety of tasks and provide feedback in the form of audio, visual, and tactile information to the human operator with a complete array of displays and controls in a remote locale. These teleoperators exist in a crude form today as industry's robots. If the computer was the single most significant invention of the twentieth century, the area of technology to benefit most from the advent of microcomputer chips is teleoperators. A glimpse further into the future reveals a time when humans will be

sheltered from adverse environments by telerobots/teleoperators. Teleoperators will be used in environments too hostile or too remote for humans. These include, for dangerous jobs such as cleaning radioactive spills or other toxic wastes. In addition, the quality of life for handicapped people can be improved through research and development of teleoperators in the form of artificial limbs. The purpose of this paper is to introduce the reader to teleoperators, telepresence, developments in the areas of kinesthetic and tactile feedback and the necessity for more research in the area of tactile feedback in teleoperators.

34975 (CONF-870245—, pp 379-386) **Permitting of research, development and demonstration projects under the Resource Conservation and Recovery Act.** Sargent, T.N.; Lane, D.C. (Engineering-Science, Inc., Atlanta, GA). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Under the Resource Conservation and Recovery Act (RCRA), passed by the US Congress in 1976, the US Environmental Protection (EPA) is required to develop regulations for issuing permits for the treatment, storage and disposal of hazardous waste. The first set of regulations was promulgated on November 19, 1980. In 1984 the US Congress passed the Hazardous and Solid Waste Amendments of 1984 (HSWA) which gives the EPA authority to issue research, development and demonstration (RD & D) permits for innovative and experimental hazardous waste treatment technologies and processes. The intent of including the RD & D permitting provision in HSWA is to encourage the regulated community to develop alternatives to land disposal of hazardous wastes. To achieve this purpose the EPA is authorized to modify or waive most of the complex RCRA permit application and procedural requirements. The requirements that cannot be waived or modified by EPA are the financial responsibility and public participation requirements.

34976 **(DOE/BP/18508—1) Compendium of environmental and safety regulations and programs affecting residential wood heating appliances.** (OMNI Environmental Services, Inc., Beaverton, OR (USA)). Sep 1986. Contract RP79-84BP16937. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87008883.

This report provides detailed information about existing and proposed regulatory efforts and programs aimed at minimizing undesirable environmental and safety impacts associated with residential wood combustion. It identifies existing regulations, codes and programs, and provides additional insight into the developing trends within the regulatory and industrial framework surrounding residential wood combustion within the United States.

34977 **(DOE/OR/21400—T306) ORNL Research Programs related to chlorofluorocarbon (CFC) alternatives.** Fairchild, P.D. (Oak Ridge National Lab., TN (USA)). 13 May 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010381.

Testimony covered: uses and control impacts; federal/Department of Energy role; and relevant DOE research and development (absorption cycle technology, advanced insulation, novel thermodynamic cycles, fluid substitutes and recovery technology, development of replacement chemicals, development of recycling and recovery practices, development of alternative technologies, and resource requirements and schedules for accomplishment). (PSB)

34978 **(PB—87-162913/XAB) Identification of high-risk occupational groups and industrial processes using RTECS/NOHS (Registry of Toxic Effects of Chemical Substances/National Occupational Hazard Survey) data. Final report.** Pielmeier, G.R. (Tracor JITCO, Inc., Rockville, MD (USA)). Nov 1979. 95p. NTIS, PC A05/MF A01.

Algorithms were developed that enable data to be combined from two NIOSH data files which contain information pertinent to worker exposure to toxic chemicals in the workplace. These two files were the Registry of Toxic Effects of Chemical Substances (RTECS) and the National Occupational Hazard Survey (NOHS). Data in the RTECS database indicate only the degree of toxicity of individual chemicals. Data in the NOHS data base indicate only the extent to which workers are exposed to chemicals and to other potential hazards. The algorithm developed not only allows the data contained in each of the data bases to be merged, but it also permits the production of five indexes. The Hazard Risk Index lists chemicals common to both original data bases ranked by the toxicological risk they pose. The Adjusted Hazard Risk Index lists the chemicals common to both ranked by their toxicological risk and the extent of worker exposure. The Industry Risk Index lists industries at the two-, three-, and four-digit Standard Industrial Classification levels covered in the NOHS data base, ranked by the potential risk due to chemical exposure of workers in each industry.

34979 **(PB—87-165619/XAB) Evaluation of thirteen spill response technologies. Final report, March 1983-September 1985.** Evans, M.L.; Carroll, H.A. (Science Applications International Corp., McLean, VA (USA)). Mar 1987. 96p. NTIS, PC A05/MF A01.

Thirteen spill response devices, concepts, or prototypes, developed under previous contracts to the U.S. Environmental Protection Agency for detection, containment, and cleanup of chemicals were evaluated by potential users and manufacturers. The main goal of the project was to inform potential users and manufacturers of the existence and technical functions of each concept, device, or prototype; its stage of development; and its intended uses. The evaluations in the report were offered by potential users and manufacturers after they examined the devices or the available technical literature on the devices. The 13 devices included: the capture and containment bag; the cholinesterase antagonist monitors (CAM-1 and CAM-4); the emergency collection system; foamed concrete; the insoluble sinkers detectors; the hazardous materials identification kit (HMIDK); the lactate dehydrogenase (LDH) test method; the leak plugger; the oxidation/reduction field-test kit; the particle-size analyzer; the sorbent oil recovery system; vapor-control coolants; and vapor-control foams. The activities used to inform potential users and manufacturers about the devices included presentations, mailings, exhibits at conferences, and publications in trade magazines. In addition, value-engineering analyses were performed for two prototypes. These activities resulted in many valuable comments from potential users and manufacturers that may be beneficial to future development programs for these and similar devices. The study generated a high degree of interest in most of the prototypes.

34980 **(PB—87-169272/XAB) Resource Conservation Recovery Act notification data file. Data file.** Levy, S.; Murray, P.; Partington, E. (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 31 Dec 1986. 1p. NTIS CP T03.

Supersedes PB—86-121670; Source tape is in the EBCDIC character set. This restricts preparation to 9 track, one-half inch tape only. Identify recording mode by specifying density only. Call NTIS Computer Products if you have questions.

The file contains data compiled for the Resource Conservation Recovery Act. Notification of Hazardous Waste Activity, EPA Form 8700-12 was used to collect the data. The file was updated with information compiled from the Application for a Hazardous Waste Permit, EPA Form 3510-3. The data includes names and addresses of the facility owner and operator, as well as the facility contact name and phone number. The data indicate whether a facility is a generator, treatment/storer/disposer, and/or transporter of hazardous waste. There is also a listing of code numbers of waste handled taken from 40 CFR Part 261.

34981 **(PB—87-178695/XAB) Plan for a hazardous-waste storage facility in Iowa.** (Iowa Dept. of Natural Resources, Des Moines (USA)). Jan 1987. 38p. NTIS, PC A03/MF A01.

Senate File 463, passed by the 71st General Assembly, directed the Department to submit a plan for the siting and construction of an above-ground facility for the long-term storage of hazardous wastes. Designing the facility is expected to cost over $700,000. These cost factors are obvious elements of future decisions on Iowa's means of handling the hazardous wastes generated in the State. At least 5 years of planning and development must come before the facility would be operational. The project would be controversial, and would require extensive public information ef-

forts and continued support of elected officials to stay on schedule. Despite the amount of time and money needed for this project, a facility is recommended for the safe, legal, and economic management of hazardous wastes generated in Iowa.

34982 **(PB—87-945000/XAB) Hazardous-Waste Collection Data Base (for microcomputers). Data files.** Roth, B.; McNamara, E. (Environmental Protection Agency, Washington, DC (USA). Information Management and Services Div.). 1987. vp. NTIS Subscription.

The data file is contained on 5 1/4-inch, double sided, double density diskettes, compatible with the IBM PC microcomputer. The diskettes are in the dBase III format. Available on subscription, North American Continent price $325.00/year; individual issue $125.00. Issued quarterly.

The Hazardous Waste Collection Data Base is maintained on an IBM PC/AT. The Data Base is updated on a quarterly basis. The Hazardous Waste Collection Data Base, written in dBase III, was developed to increase access to the entire EPA Hazardous Waste Collection and assist in the transfer of information among EPA Headquarters, Regional Offices and laboratory libraries. The collection contains: EPA Reports, Books, Office of Solid Waste and Emergency Response (OSWER) policy and guidance directives, periodicals, relevant Federal Register Notices, and a listing of commercial data bases with hazardous-waste information that are available through the EPA library network. Hard copies of these documents and the data base are available in the Headquarters and Regional libraries, the National Enforcement Investigations Center, and the EPA laboratory libraries in Cincinnati, Edison, RTP, Ada, and Las Vegas. A list of the documents is available in all other EPA laboratory libraries. The data base provides automated search and retrieval capabilities by the following access points: keyword/subject heading, abstract, title, author, sponsoring organization/office, project manager's name, contract number, and more. The data base is organized into three areas: periodicals, commercial databases, and monographs (books, non-EPA Reports; EPA Reports; OSWER policy and guidance directives).

34983 **Cancer risk management.** Travis, C.C.; Richter, S.A.; Crouch, E.A.C.; Wilson, R.; Klema, E.D. (Oak Ridge National Lab., TN). *Environmental Science and Technology;* 21: No. 5, 415-420(May 1987). Contract AC05-84OR21400.

Various federal agencies are responsible for promulgating regulations and standards to protect the public from exposure to environmental carcinogens. Although many factors are considered in the decision to regulate a carcinogen, one important issue concerns the probability that individuals in an exposed population will develop cancer. What has not been clear, however, is the level of cancer risk that triggers regulation, or whether there is consistency within and between agencies in arriving at the risk decisions that underpin regulatory action. The authors retrospectively reviewed the use of cancer risk estimates in prevailing federal standards and in withdrawn regulatory initiatives to determine whether any simple patterns emerge to correlate risk level with regulatory action. The results show that there are definite patterns and a surprising degree of consistency in the federal regulator process.

2904 Natural Resources

REFER ALSO TO CITATION(S) 34586, 34730, 34989, 35781, 35782

34984 **(PB—87-167540/XAB) Domestic consumption trends, 1972-82, and forecasts to 1993 for 12 major metals. Information Circular/1986.** (Bureau of Mines, Washington, DC (USA)). 1986. 41p. (BM-IC—9101). NTIS, PC A03/MF A01.

Library of Congress catalog card no. 86-600154.

Consumption and intensity of use trends for 12 metals, by industrial end use, were estimated for 1972 through 1982 by the Bureau of Mines and U.S. Department of Commerce. The trends were then forecast through 1993 using standard statistical methods. The intensity of use measure selected is the quantity of metal consumed per constant dollar output of a specific industrial sector. The metals studied were aluminum, chromium, cobalt, copper, lead, manganese, nickel, the platinum-group metals, tin, titanium, tungsten, and zinc.

34985 **(PB—87-172672/XAB) Water and the Michigan economy: estimating the economic value of Michigan's fresh water. Final report.** Libby, L.W.; Hoehn, J.P.; Caudill, J.; Walker, D. (Michigan State Univ., East Lansing (USA). Inst. of Water Research). 30 Jun 1986. 144p. NTIS, PC A07/MF A01.

Michigan's water resources are an important input into a range of residential, agricultural, recreational, and commercial activities. One way to quantify the tradeoffs involved in water-quality management is to measure the economic value of water resources to the various interests involved. The primary objective of the study was to contribute to the development of information and procedures for assessing the economic value of Michigan's water resources. Given the existing policy demands and the generic nature of economic valuation procedures, the study focused on the management tradeoffs involving groundwater resources.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 34516, 34517, 34518, 34523, 34530, 34531, 34534, 34535, 35002, 35016, 35197, 35891

34986 **(AD-A—178725/8/XAB) Mathematical modeling and large-scale computing in energy and environmental research.** Ewing, R.E. (Wyoming Univ., Laramie (USA)). Aug 1985. 18p. NTIS, PC A02/MF A01.

Pub. in The Merging of Disciplines: New Directions in Pure, Applied, and Computational Mathematics, 45-59(Aug 1985).

The advent of new supercomputer architectures is helping to revolutionize the modeling process for large-scale physical problems. The advance in computational capabilities has allowed the incorporation of more physics in the model. This has greatly increased the complexity of the mathematical models necessitating the application of a wider range of mathematical research. Through this development, the distinction between much of pure and applied mathematics is rapidly disappearing. The breadth of the modeling process, utilizing physical, mathematical, numerical, and computational concepts, will be emphasized. Specific applications involving energy-related and environmental problems will be presented and used to illustrate the need for strong interrelationships between the aspects of the steps in modeling.

34987 **(CONF-8410469—) 7th cooperative working conference of the State and Laender in the field of raw materials and energy research. Papers and discussions.** (Amt der Steiermaerkischen Landesregierung, Graz (Austria). Abt. fuer Wissenschaft und Forschung). Mar 1985. 128p. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752434.

From 7. cooperative working conference of the State and Laender in the field of raw materials and energy research; Eisenerz, Austria (4 Oct 1984).

Within the framework of the cooperation between the State and the Laender in the field of raw materials and energy research, a workshop is organized every year in one of the states. In this workshop, the main research issues of the organizing state are presented and the states are offered an opportunity to exchange their experiences. The 7th workshop took place in Eisenerz on October 4-5, 1984 and was titled '10 years of raw materials research in the Steiermark' as 10 years had passed since the State Government of the Steiermark had decided in 1974 to record the raw material resources of the Steiermark and it seemed to be the time to report on the results. Thus, the results of the raw material research over the past ten years were documented for this workshop.

34988 **(NP—7752437) Fraunhofer Institute for Environmental Chemistry and Ecotoxicology. Research activities in 1985.** (Fraunhofer-Institut fuer Umweltchemie und Oekotoxikologie, Schmallenberg (Germany, F.R.)). 1985. 106p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752437.

The research activities of the institute aim at providing practicable and reliable contributions for the assessment of chemicals and pollutants as well as for remedial measures. The studies include

the elaboration of methods to evaluate the environmental hazard of chemicals and their risk for the environment. Basicly, the research aims of the institute are not restricted to the determination and interpretation of potential environmental danger. The basic concept is to act as a link between environment and technology giving high priority to studies concerned with the prevention of environmental damage.

34989 (NP—7752440, pp 17-21) **EDP-aided mineral deposit archives.** Wolfbauer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Sektion Rohstofforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The Eastern Alps mineral deposit archives were established throughout a period of almost ten years and have been made available nation-wide in the form of some 16,000 data sheets on deposits of mineral raw materials. This survey is to be processed as much as possible to meet the requirements of the interested specialist public and policy-makers in an adequate way. To this end, a pilot project will be worked out for developing and establishing an EDP-aided information and documentation system covering geoscientific and raw-material-economy data of both a library and a non-library type which will constitute both a prototype for and a contribution to a nation-wide specialist information and documentation system which is exemplified by the Steiermark region. The project aims at the selection, structuralization, adaptation and formation of the interfaces of a data base system which will guarantee easy handling of variable text lengths of deposit designations and descriptions, as well as of supplementary library data and which will also allow easy updating. (orig./MOS).

34990 **(NUREG—1244) Plan for integrating technical activities within the US NRC [Nuclear Regulatory Commission] and its contractors in the area of thermal hydraulics.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Systems Safety). Apr 1987. 43p. NTIS, PC A03 - GPO. File Number DE87900643.

The Executive Director for Operations (EDO) directed the NRC staff to prepare a coordinated plan for the integration of technical activities within the agency and specified a number of issues to be addressed. This report summarizes the status of agency programs involved in thermal hydraulic research and proposes management methods to accomplish the EDO's directives.

34991 **(PB—87-177804/XAB) Annual report to the Congress, fiscal year 1985 (Office of Technology Assessment).** (Office of Technology Assessment (U.S. Congress), Washington, DC). Mar 1986. 122p. (OTA-A—289). NTIS, PC A06/MF A01.

See also report for FY 86, PB—87-177812.

This report summarizes the activities of the Office of Technology Assessment (OTA) for the calendar year 1985. Included are discussions of its organization and operation; summaries of assessments completed during 1985; descriptions of work in progress; a list of staff members, advisors, and panel members. A copy of the Technology Assessment Act of 1972 is also included.

34992 **(PNL-SA—14612) An integrated approach to commercialization and R and D planning with emphasis on Japanese methods.** Harrer, B.J.; Smith, R.M. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 16p. (CONF-870416—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011151.

From 14. annual energy technology conference and exposition; Washington, DC, USA (14 Apr 1987).

This paper identifies the problems associated with commercialization of new technologies, examines the institutional mechanisms for coordinating energy technology R & D and commercialization in Japan and presents a methodology for integrating R & D and commercialization activities.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 34586, 34681, 34966, 35012, 36227

34993 **(SIS—1986:10) Information at radiation accidents. A study on the needs for information among health visitors and farmers.** Greger, T.; Cristensen, T. (Statens Inst. for Straalehygiene, Oslo (Norway)). 1986. 25p. (In Norwegian). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752194.

This study was undertaken in order to plan an information strategy for possible future accidents involving radioactivity. Six health visitors and six farmers working in the districts of Norway which received the largest amounts of fallout from the Chernobyl accident, were interviewed. The questions were intended to give an indication of their knowledge about radioactivity and radiation, as well as their needs for information in case of a future accident. The results indicate a relatively low educational background in radiation physics and risk estimation. On the other hand the two groups showed a remarkable skill and interest in doing their own evaluation on the background of information that was linked to their daily life. It is suggested that planning of information in this field is done in close cooperation with the potential users of the information.

34994 **Nuclear safety and security in a changing world.** Badolato, E.V. (U.S. Dept. of Energy, Washington, DC). *Journal of the Institute of Nuclear Materials Management;* **15**: No. 1, 13-17(Oct 1986).

Two major crises of 1986 - the Chernobyl nuclear accident and international terrorism have had the effect of making what we all do even more critically important for U.S. national security and for the security of the world. Chernobyl can be a starting point for efforts to make nuclear power systems safer and more benign. It also poses very basic questions for our nuclear arms control activities. A fundamental objective of the Administration's arms control policy is to achieve substantial and equitable reductions in U.S. and Soviet nuclear forces with effective verification. However, Chernobyl served to remind us once again of the obsessive secretiveness of the Soviet Union and the difficulties of obtaining information on Soviet Union and the difficulties of obtaining information on Soviet nuclear weapon activities. All of this points to the importance of developing improved monitoring technologies and obtaining Soviet agreement on on-site inspection.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 34804

2910 Conservation

REFER ALSO TO CITATION(S) 35024, 35050, 35056, 35580

34995 **(AD-A—178353/9/XAB) Energy conservation and conversion: DOD's (Department of Defense's) progress to date. Final report.** Hoyler, M.; Salthouse, R.W.; Terapak, R.M. (Logistics Management Inst., Bethesda, MD (USA)). 15 Feb 1986. 47p. (LMI-ML—534). NTIS, PC A03/MF A01.

The Department of Defense has achieved a reduction in total energy consumption since 1975 and has made good to excellent progress against eleven of its sixteen energy conservation and conversion goals. Weak to poor performance against the remaining five goals frequently reflects good management, since the costs of achieving these goals would have exceeded the benefits of doing so. When DoD progress is compared with that of the U.S. economy overall -- which is feasible for eleven of its conservation/conversion goals -- DoD performance appears better for five goals, similar for four, and worse for two.

34996 **(DOE/BP/14969—3) Effects of weatherization on loads of selected PURPA metered residences: Executive summary.** Perry, D.; Ritland, K.; McDonald, C. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Sep 1986. Contract AC79-83BP14969. 29p. (SRC—7237-R2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009941.

This study analyzes the effects of the installation of selected retrofit conservation measures on electrical load characteristics for 119 single-family residences in the Pacific Northwest. The conservation measures include heat pumps, water heater wraps, and retrofit weatherization measures, such as increases in floor, ceiling, wall and duct insulation, and insulation windows.

34997 **(DOE/CE/40732—T4) Energy efficiency in American industry: Leveraging a national effort for increasing industrial conservation technology: [Final report].** (ACEC Research and Management Foundation, Washington, DC (USA)). [1987]. Contract FG01-85CE40732. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011024.

Purpose of this report is to describe the results of an industrial energy management project undertaken by the ACEC Research and Management Foundation (ACEC/RMF). Conceived by ACEC/RMF in an effort to increase the energy efficiency of small and medium sized industrial facilities, this project has provided the consulting engineering profession and industry with current technical reference resources. Purpose of this project was to develop a series of reference resources for those who seek up to date information concerning ways to increase industrial energy efficiency. It was intended that these resources be aimed at increasing the technical base of knowledge in the engineering profession relative to the effective use of energy. The target audience was small and medium sized industries, which often do not have an in-house engineering staff to initiate and maintain energy management programs and projects.

34998 **Performance contracting for energy savings in New Jersey.** Freeman, G.R.; Shepard, M. (NJ Dept. of Energy, Newark, NJ). pp 81-88 of Financing energy conservation. Weedall, M.; Weisenmiller, R.; Shepard, M. Washington, DC; American Council for an Energy Efficient Economy (1986).

Each year over $10 billion leaves New Jersey's economy to pay for energy services. These high energy costs are particularly painful for public facilities which already face difficult budget choices. Financially strapped public and non-profit institutions such as municipalities, schools and hospitals cannot afford to invest in energy efficiency. To resolve this predicament, the New Jersey Department of Energy has established a program to facilitate performance contracting by local governments for energy improvements. This chapter examines New Jersey's approach and discusses the implications of this experience.

34999 **Testing conservation incentive levels through system simulation.** Bull, M. (Bonneville Power Administration). pp I17-I29 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—).

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

The Office of Conservation of the Bonneville Power Administration has constructed an integrated system dynamics model for conservation program planning. This model represents a breakthrough for BPA in its ability to: (1) model conservation programs in direct interaction with system operation, economic activity, ratemaking and financial impacts; and (2) model the market penetration of alternate conservation program and incentive designs. The program is designed to run quickly and cheaply in order to facilitate the testing of multiple policy and scenario assumptions. This paper presents the preliminary results of BPA's testing of the Regional Simulation Model, to include: the sensitivity of conservation program penetration to incentive levels and their structure; the ability to model incentive and programmatic constraints on programs; the relative redundancy of conservation subsidies under alternate incentive designs; and the trade-off between program timing and incentive levels to meet energy savings targets.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 34545, 34546, 34836, 35070

35000 **(DOE/BP/14969—4) Effects of weatherization on loads of selected PURPA metered residences: Analytical data set.** Ritland, K. (Synergic Resources Corp., Bala-Cynwyd, PA (USA)). Sep 1986. Contract AC79-83BP14969. 69p. (SRC—7237-R3). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009942.

This report describes the contents of the hourly load and customer characteristics data sets used in a study of the effects of the installation of selected retrofit conservations measures on electrical load characteristics for 119 single-family residences in the Pacific Northwest. The data sets contain economic and demographic data, and three-and-one-half years of hourly load data, for each household in the study. The load data has been merged with weather data from nearby weather stations, and a weather normalized hourly load is also included in the data set.

35001 **(NZERDC-P—109) Four futures: Energy implications of social and economic change: Scenario narratives.** Boshier, J.F.; Allan, R.R.; Ellis, M.J.; Gallacher, J.; Phillips, P.H. (New Zealand Energy Research and Development Committee, Auckland). Dec 1986. 90p. NTIS, PC A05/MF A01. File Number DE87900820.

The nature and pace of change in the energy sector since the ERDC scenarios were completed in 1976, prompted the ERDC and the Ministry of Energy in December 1982 to set up a multidisciplinary team to undertake a new scenario study. Four scenarios of social, economic and technological change between 1981 and 2031 were developed in this second scenario study to address these and related issues. The focus on society, the economy and technology was chosen to avoid the risk that energy futures would be developed in isolation from the factors which determine supply and consumption.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 34518, 34546, 34547, 34994, 34998

35002 **The Basic Energy Sciences program of the Department of Energy.** Kane, J.S. (Office of Energy Research, United States Dept. of Energy). pp 61-74 of Proceedings of the workshop on the role of basic research in science and technology: Case study in energy R & D. Washington, DC; National Science Foundation (1982). (CONF-8203218—).

From Workshop on the role of basic research in science and technology: case study in energy R and D; Washington, DC, USA (12 Mar 1982).

The Basic Energy Sciences program is a component of the Department of Energy's Office of Energy Research, the office responsible for planning and executing the Department's more basic research activities. The size of the Basic Energy Sciences (BES) program, its diversity, and its intellectual content make it perhaps unique in the scientific endeavours of the United States. This chapter emphasized how BES goes about participating in the complex endeavor that is United States science.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 34514, 34515, 34516, 34517, 34518, 34523, 34530, 34531, 34534, 34535, 34545, 34546, 34547, 34551, 34557, 34562, 34972

35003 **(ORNL/TM—10379) Coal briquetting in Haiti: A market and business assessment.** Stevenson, G.G.; Willson, T.D.; Jean-Poix, C.; Medina, N. (Oak Ridge National Lab., TN (USA)). Jun 1987. Contract AC05-84OR21400. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011951.

The investigation evaluated potential market size, financial viability, consumer acceptance, and the government policy role in promoting the manufacture and sale of briquettes in Haiti. Our re-

sults show a large and growing charcoal market in Port-au-Prince of 100,000 to 120,000 tonnes per year in 1985, much larger than previous estimates. This would support a 50,000 tonne per year coal briquetting plant. Wood users buying in lots of 100 pieces or less would provide a smaller, secondary market of about 6000 tonnes of charcoal equivalent per year. The size and competitive nature of the current charcoal transportation, wholesale, and retail distribution chain make it easily capable of distributing the coal briquettes. We investigated three coal briquetting options, each based on a different coal source: (1) Maissade lignite, (2) L'Azile lignite, and (3) imported coal. Financial analyses compare capital and operating costs with potential returns. Results indicate that the Maissade lignite is not economically viable in competition with charcoal at current charcoal prices. Both the L'Azile and imported coal options hold more promise. The investment incentives provided by Haitian government are very favorable to a coal briquetting venture. An increased tax on charcoal, currently priced below its social cost, is recommended.

2960 Electric Power

REFER ALSO TO CITATION(S) 34562, 34730, 34836, 34996, 35000

35004 **(AD-A—178170/7/XAB) Stator conductor and bore seal study for the advanced high-power generator program. Final report, April 1980-November 1986.** Druzsba, A. (AiResearch Mfg. Co., Torrance, CA (USA)). Nov 1986. 63p. (—86-60320). NTIS MF A01.

Availability: Microfiche copies only.

This report describes the results of a preliminary study to simplify the 36-strand, liquid-cooled stator conductor for the advanced 5-MW, high-power generator. A specially configured four-strand conductor significantly simplifies the fabrication process with very little loss in performance or specific power.

35005 **(DOE/BP—674) 1985 Firm Displacement Power rate proposal: Administrator's record of decision.** (USDOE Bonneville Power Administration, Portland, OR). Jun 1986. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010351.

Bonneville Power Administration (BPA) first proposed a Firm Displacement Power (FD) rate in September 1984 as part of the initial 1985 wholesale rate proposal. The proposed FD rate was part of a package of rates designed to provide BPA flexibility in marketing its surplus firm power in a competitive and uncertain market. Believing that the rate needed further study, on December 11, 1984, BPA withdrew the proposed FD rate from consideration in the 1985 rate proceeding. BPA continued to pursue discussions with Pacific Northwest (PNW) and Pacific Southwest (PSW) utilities regarding potential sales of PNW surplus firm power to California markets. When several utilities expressed interest in the FD concept (in which BPA would sell its surplus firm power on a long-term basis to PNW utilities, who would use the FD power to serve their regional load and make a long-term firm sale of their own generating resources to the PSW), BPA held a series of weekly informal public meetings. The series of meetings, which began in June 1985, included discussion of contract issues. After assessing the discussions held at the first four meetings, BPA announced at the July 12, 1985, meeting that the FD rate would be developed in a hearing process pursuant to section 7(i) of the Pacific Northwest Electric Power Planning and Conservation Act (Pacific Northwest Power Act).

35006 **(DOE/BP—746) Draft 1987 resource strategy.** (Bonneville Power Administration, Portland, OR (USA)). 11 Dec 1986. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87009936.

This document outlines the Resource Strategy process that Bonneville uses to assess its future loads and resources. That process includes a public participation component. This is a draft document. Conclusions reached here are tentative, and all information in this draft is open to public review and comment. This volume contains the major issues addressed this year; new information that has changed the Resource Strategy environment; a summary of the findings of the Draft WNP-1 and -3 Study; conservation and generating resources program directions for the near term, including a synopsis of Bonneville's Workplans in response to the Council's Plan; descriptions of the decision factors available to evaluate resource strategies; a summary of the analysis and conclusions for conservation and generating resources; and descriptions of ongoing work related to resource planning.

35007 **(DOE/BP—760) Pacific Northwest loads and resources: Executive summary.** (USDOE Bonneville Power Administration, Portland, OR. Div. of Power Resources Planning). Dec 1986. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009938.

The Bonneville Power Administration is charged with assuring its customers an adequate, cost effective and environmentally sound source of electricity. To plan for the uncertainties faced by the region over both the near and long terms requires extensive knowledge of how much electrical energy or capacity is needed and when. The BPA Pacific Northwest Loads and Resources Study establishes a set of planning bases. Generally, forecasted loads are deducted from available generation to determine whether a surplus or deficit prevails. This is done for each of three cases: high, medium, and low load growth. If the balance is positive in any particular year, a surplus of energy and capacity is available for sale. If the balance is negative, generation or conservation additions are needed.

35008 **(DOE/EIA—0226-87/02) Electric Power Monthly, February 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Feb 1987. 46p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. File Number DE87010361.

In February 1987, net generation from nuclear-powered units represented a record share, 18.9%, of the total electricity produced during the month. The previous record share, 18.5%, occurred in December 1986. Net generation from nuclear energy was 36,598 gigawatthours in February 1987, 12% higher than in February 1986. Net generation from hydroelectric units was 21,216 gigawatthours in February 1987, 9% lower than the February 1986 level. In comparison with previous February generation levels, the hydroelectric net generation level has not been this low since February 1981 when electric utilities reported 21,099 gigawatthours. The reservoir levels in the Northwest, an area which is a major producer of hydroelectricity, were low in February 1987. As a result, electric utilities in the Pacific Contiguous Census Division reported 23% less generation from hydroelectric units in February 198 as compared to the same month a year ago. In January 1987, (the latest month of available cost data) the average cost of the fossil fuels delivered to electric utility steam plants (of 50-megawatt installed nameplate capacity or larger) was lower than in January 1986. Specifically, on a cents-per-million-Btu basis, the average cost of coal was 150.4, 6% lower, the average cost of petroleum was 370.0, 24% lower, and the average cost of gas was 233.6, 26% lower. When the average cost of fuels in January 1987 was compared with the average cost of fuels for December 1986, electric utilities paid a 2% increase for deliveries of gas and a 20% increase for deliveries of petroleum. However, the cost to utilities for deliveries of coal decreased 1% for this time period. 27 tabs.

35009 **(DOE/EIA—0226(87/03)) Electric power monthly, March 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 17 Jun 1987. 46p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. File Number DE87010973.

In March 1987, total net generation reached a record level for March generation, 201,837 gigawatthours, 3% higher than in March 1986. All energy sources with the exception of petroleum and water showed net generation levels that were higher in March 1987 than in March 1986. 26 tabs.

35010 **(EPRI-EL—5178) Composite system reliability evaluation methods: Final report.** Pereira, M.V.F.; Pinto, L.M.V.G.; Oliveira, G.C.; Cunha, S.H.F. (Centro de Pesquisas de Energia Eletrica, Rio de Janeiro (Brazil); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 137p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920462.

The objectives of this research are: development of a conceptual framework for composite generation / transmission reliability evaluation; comparison of three alternative approaches within this framework: state-space decomposition, contigency enumeration, and Monte-Carlo; analysis of variance reduction techniques in Monte-Carlo methods; and analysis of approaches combining state-space decomposition, contingency enumeration and Monte-Carlo. Case studies with a modified 24-bus IEEE reliability test system and the 140-bus SYREL test system are presented and discussed.

35011 **(EPRI-EM—5194) Variable-response model of electricity demand by time of day: Results of a Wisconsin pricing experiment: Final report.** Lillard, L. (RAND Corp., Santa Monica, CA (USA); Electric Power Research Inst., Palo Alto, CA (USA)). Jun 1987. 57p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920457.

Observationally alike households may differ in demand parameters and thus in economic quantities that are functions of those parameters. We have proposed a methodology for dealing with this variation. Estimation of both translog and CES versions of the model with data from the Wisconsin Electricity Pricing Experiment revealed considerable variation among households in time-of-day electricity consumption demand parameters for both summer and winter seasons and for several different definitions of the peak period. Observed household characteristics explained only a small share of total household differences, but permanent household differences dominated month-to-month variation in either expenditure shares or log consumption ratios in most cases. Permanent differences among households are important relative to total variation, including transitory month-to-month variation. We calculated various economic variables from the demand parameters, including the partial elasticity of substitution, compensated and uncompensated elasticities, and a measure of electricity expenditure under peak load pricing required to maintain the utility level under flat rate pricing relative to the flat rate expenditure. Because these are nonlinear functions of the household demand parameters, the mean parameter value over households with different demand parameters may be substantially different from the value of the function at mean values, under the representative household paradigm. For time-of-day electricity demand, variation among households is significant but small relative to mean parameter values. Therefore, controlling for the effect of household variation makes little difference in these mean calculations, but it does imply substantial variation among households in the welfare implications (and elasticities of response) of the introduction of time-of-day pricing. 25 refs., 12 tabs.

35012 **(PNL—6193) Long-term need for new generating capacity.** Bloomster, C.H.; Merrill, E.T. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010026.

Electricity demand should continue to grow at about the same rate as GNP, creating a need for large amounts of new generating capacity by the year 2000. Only coal and nuclear at this time have the abundant domestic resources and assured technology to meet this need. However, large increase in both coal and nuclear usage will not be acceptable to society without solutions to many of the problems that now deter their increased usage. For coal, the problems center around the safety and environmental impacts of increased coal mining and coal combustion. For nuclear the problems center around reactor safety, radioactive waste disposal, financial risk, and nuclear materials safeguards. The fuel requirements and waste generation for coal plants are orders of magnitude greater than for nuclear. Technology improvements and waste management practices must be pursued to mitigate environmental and safety impacts from electricity generation. 26 refs., 14 figs., 23 tabs.

35013 **(PNL-SA—14814) The benefits of using end-use load-shape data for effective demand-side management.** Hauser, S.G.; Scheer, R.M. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. Contract AC06-76RL01830. 11p. (CONF-870642—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011154.

From 3. national conference on utility DSM programs: demand-side management strategies in transition; Houston, TX, USA (16 Jun 1987).

Some of the benefits of collecting end-use data are discussed and several examples of how the data can be applied based on our experience with a large-scale metering project conducted for the Bonneville Power Administration (BPA) by the Pacific Northwest Laboratory are presented. For this project (the End-use Load and Conservation Assessment Program or ELCAP), approximately 430 residences and 140 commercial buildings have been instrumented with field data acquisition technology that captures up to eight different end-uses in each residence and up to 22 end-uses for each commercial building. Meteorological data and internal temperatures for many sites are also measured. Most of the sites have at least one years worth of data with a 90% or better data capture rate.

35014 **(TVA/OP/EDT—87/21) A roundup of utility research and development products of specific benefit to public power.** Elder, H.W. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Power; Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Energy Demonstrations and Technology). 1987. 23p. (CONF-8703137—Exc.). NTIS, PC A02/MF A01. File Number DE87900610.

From American Public Power Association's engineering and operations workshop; Nashville, TN, USA (16 Mar 1987).

The Tennessee Valley Authority (TVA) has a special interest in research, development, and demonstration (RD and D) activities that improve economic opportunities through efficient production and use of electric power. History in the TVA area over the past 50 years has shown that an ample supply of electricity at the lowest possible cost has been a major force in upgrading the standard of living for the residents of the Tennessee Valley. Advances in technology are essential to the link between electrical power and economic progress. TVA's expenditures for RD and D activities have now grown to approximately $50 million per year. The projects are wide ranging in technical nature and include improvements in production, distribution, and end use of electricity. Three areas of the extensive program are highlighted: the use of fiber optics in utility applications, the electrotechnology development program, and the dry-scrubbing technology development.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 34972, 35050, 35070

35015 **Researching the human factor in Hood River: Buildings don't use energy, people do.** Keating, K.M.; Flynn, C.B. (Bonneville Power Administration). pp I250-I259 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—).

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

While the technical aspects of the intensive research associated with the Hood River Project are well documented in other papers, this paper emphasizes the human, behavioral side of the research. The research team, motivated by a concern for the social impacts of the project, by an awareness of the role of human behavior in energy consumption, and by the central objective of the project-penetration-has put a strong emphasis on the study of the community and the household occupants. Seven such studies are briefly described in this paper.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 34738

35016 (CONF-850626—, pp 300-311) **Renewable technology research and development overview.** San Martin, R. (Dept. of Energy). Jun 1985. NTIS, PC A23/MF A01. File Number DE87008911.

From Renewable energy technologies symposium and international exposition; Anaheim, CA, USA (3 Jun 1985).

An overview of DOE research and development programs on renewable energy technologies demonstrates a range of projects for both centralized and decentralized facilities, for a range of temperatures, and for solid, liquid, and gaseous fuels. A summary of purpose, technology efforts, and status is given for both active and passive solar buildings, solar thermal, photovoltaics, ocean energy wind energy, biomass, and geothermal.

35017 **(PB—87-166187/XAB) Current alternative energy research and development in Illinois, December 1986.** (Illinois Dept. of Energy and Natural Resources, Springfield (USA)). Jan 1987. 133p. (IL/ENR/AE—86/01(86)). NTIS, PC A07/MF A01.

See also report dated Dec 85, PB—86-172574.

The directory constitutes an inventory of recent activities involving research, development, and demonstration projects of nonfossil, nonnuclear energy sources. Projects discussed in the directory were either in process in October 1986 or had been completed after December 1985. Reports on 56 alternative energy projects are included and fall into eight major categories. The topics with actual numbers of reports are as follows: Bioenergy 24; Solar heating and cooling 18; Solar photovoltaics 8; Geothermal and ocean thermal 2; Wind energy 3; and Waste heat and materials recovery.

30 DIRECT ENERGY CONVERSION

REFER ALSO TO CITATION(S) 34995

3001 Mhd Generators

35018 **(AD-A—178869/4/XAB) Investigation of rocket-powered, open-cycle, magnetohydrodynamic generators for high, pulsed power needs in space. Master's thesis.** Power, J.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Nov 1986. 71p. (AFIT/GSO/ENP—86D-1). NTIS, PC A04/MF A01.

This investigation examined the possibility of using a rocket-powered magnetohydrodynamic generator for pulse power in space of 300 megawatts (MW). The result is a preliminary design of an MHD generator using an open cycle disk channel and a single superconducting solenoid coil. The disk channel acts as a thrust deflector, and internal vanes counteract induced vorticity. The use of a solid-fuel-wafer grain design rocket motor is proposed for increased electrical conductivity and pulse operation of the generator. Using conservative parameters, a generator design capable of being carried on one or two space-shuttle launches is developed with estimated mass of 24,450 kg and estimated power output of 1346 MW. The nominal operation time before refurbishment is 115 seconds; the restriction operation time is deterioration of the channel throat. This design exceeds present nuclear and solar-cell power systems in power output per unit mass.

35019 **(DOE/PC/90255—T1) Coal-Fired MHD Combustor Development Project: Phase 4, First quarterly technical progress report, February through April 1987.** (TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.). Jun 1987. Contract AC22-87PC90255. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010771.

This first quarterly technical progress report of the Coal-Fired MHD Combustor Development Project (Phase IV) presents the accomplishments during the period of April 10 to April 30, 1987. Progress during this reporting period is summarized: (1) Project planning activities were accomplished during this period were related to all aspects of managing and performing on the MHD Phase IV Project. (2) Two combustor component sections of the 50 MW/sub t/ combustor installed at CDIF were removed from the test stand and returned to TRW for repair. Repairs were in progress. (3) Continued support of the test activities at CDIF was provided during this report period. Because of the combustor hardware repairs that were underway there were no test firings. The engineering support activities were focused, therefore, on combustor/power train data reduction and data analysis activities for the previously completed tests.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 34471, 35041

35020 **(DOE/MC/23136—2293) The effects of halides on the performance of coal gas-fueled molten carbonate fuel cells: Topical report.** Magee, T.P.; Kunz, H.R.; Krasij, M. (USDOE Morgantown Energy Technology Center, WV; International Fuel Cells Corp., South Windsor, CT (USA)). Dec 1986. Contract AC21-86MC23136. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87001079.

A literature survey and thermodynamic analyses were performed to determine the anticipated effects of chloride and fluoride present in gasified coal on the performance of molten carbonate fuel cells. The literature survey encompassed limited tests in which hydrogen chloride was introduced in the molten carbonate cell reactants, properties of mixtures of lithium and potassium carbonates with lithium and potassium chlorides or fluorides, and the effects of chlorides and fluorides on the corrosion of molten carbonate cell materials. The thermodynamic analyses included calculations of the conditions at which nickel anodes will react with the halides, the equilibrium composition of the electrolyte as a function of gas-phase hydrogen chloride and hydrogen fluoride partial pressure, and the vapor pressure of the alkali metal halides as a function of electrolyte halide ion fraction. A summary is presented of the likely effects of chloride and fluoride on molten carbonate fuel cells. 21 refs., 16 figs.

35021 **(IS-T—1303) Anodic oxygen-transfer electrocatalysis at pure and modified lead dioxide electrodes in acidic media.** Yeo, In-Hyeong. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010928.

Pure β-lead dioxide and lead dioxide doped heavily with other metal oxides were prepared by electrochemical deposition on a gold, rotated disc electrode (RDE) in 1.0 M $HClO_4$. These electrodes were compared for their electrocatalytic support of anodic reactions accompanied by transfer of oxygen from the aqueous solvent to the reaction product. The heterogeneous rate constants of several inorganic and organic reactions were determined with emphasis on the reaction $Mn(II) + 4H_2O \rightarrow MnO_4 + 8H^+ + 5e$. The electrocatalytic effects of numerous dopants were determined and bismuth oxide was found to cause the greatest increase in rates of anodic oxygen-transfer reactions. Physical properties of the bismuth mixed lead oxide electrodes were studied. The greatest rate of oxidation of Mn(II), smallest O_2 evolution overpotential, and highest preferred orientation level occurred for mixed oxides electrodeposited from solutions with Bi(III)/Pb(II) ratio of 0.7/1.0.

35022 **Serially connected solid oxide fuel cells having monolithic cores.** Herceg, J.E. (to Dept. of Energy, Washington, DC). US Patent 4,666,798. 19 May 1987. Filed date 20 May 1985. vp.

This patent describes a fuel cell for electrochemically combining gaseous fuel and oxidant for generation of galvanic output, comprising an array of longitudinally arranged fuel cell segments in series connection. Each fuel cell segment consists essentially of thin layers of cathode material and anode material respectively sandwiching a thin layer of electrolyte material constructed to define parallel fuel and oxidant passageways of substantially uniform transverse cross section. The inside faces thereof are only the anode material or only the cathode material establishing serial flow connections between the respective anodes of adjacent fuel cell segments and the respective cathodes of adjacent fuel cell segments, interconnect material different than either electrode material establishing electrical series connection between the respective cathodes and anodes of longitudinally adjacent fuel cell segments.

35023 **Thermoelectric conversion by hydrogen pressure cells.** Salomon, R.E. (Chemistry Dept., Temple Univ., Philadelphia, PA 19122). pp 491-500 of Alternative energy sources VII. Veziroglu, T.N. New York, NY; Hemisphere Publishing (1985). (CONF-851201—).

From 7. Miami international conference on alternative energy sources; Miami Beach, FL, USA (9 Dec 1985).

The work described in this paper is aimed at the development of a new type of transducer for the conversion of thermal energy into electrical energy. It bears a relationship to both thermocouple type converters and to regenerative fuel cells. It has evolved from attempts to utilize hydrogen pressure (concentration) cells to convert oceanic wave energy into electricity and from attempts to utilize hydrogen pressure cells, together with rechargeable metal hydrides, to convert heat into electrical energy. Hydrogen pressure cells consist of a protonic conductor bordered by electrocatalytic electrodes which are porous to hydrogen. In operation, the electrodes are exposed to hydrogen at pressures P1 and P2 and under conditions of small electrical load the Nernst cell voltage, Eo, exists across the cell, where Eo is given as Eo = RT/2F LOG(P1/P2) where T is the absolute cell temperature and F is the Faraday. The high pressure side, where hydrogen is oxidized, is negative.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

35024 **(DOE/BP—753) Office of Conservation 1986 yearbook.** (USDOE Bonneville Power Administration, Portland, OR. Office of Conservation). 1986. 43p. NTIS, PC A03. File Number DE87011164.

Accomplishments of BPA conservation efforts are described in the following fields: residential sector; commercial sector; industrial sector; agricultural sector; technical, financial assistance, and education; and research, development, and technical demonstration. (DLC)

3201 Buildings

REFER ALSO TO CITATION(S) 34776, 34776, 34777, 34998, 35572, 35580

35025 **(AD-A—178483/4/XAB) Survey and analysis of air-conditioner manufacturing firms and products. Technical report, August 1986-February 1987.** Potter, P.G.; Iacovitti, T.L. (Science Applications International Corp., McLean, VA (USA). Military Operations Analysis Div.). 9 Feb 1987. 85p. (SAIC—87/1504). NTIS, PC A05/MF A01.

This report documents an effort to collect data and create an automated database of air conditioner products and manufacturing firms. The survey encompassed approximately 1300 US and free-world firms. The product data base consists of information on air conditioners and related environmental control units of 6000 to 60,000 BTU/hour (BTUH) cooling capacity. It includes US military standard and commercial off-the-shelf products. In addition to products, the data base provides information on firms that provide support to air conditioning and related equipment, or that manufacture specialized or customized related products. The purpose of the data base is to help in selecting commercial products for potential military applications, using the non-developmental item (NDI) approach to development and procurement.

35026 (BNL—39542, pp 45) **Perfluorocarbon tracer (PFT) gas infiltration.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The Bonneville Power Administration (BPA) is planning to determine the extent of energy savings potentially available from the weatherization (tightening by caulking, etc.) of homes and buildings in its servicing area of Washington, Oregon, and Idaho. In addition, they are examining the benefits of new building techniques and materials on reducing air infiltration in new housing stock. As a consequence of their weatherization programs, BPA is, of course, concerned about the impact on indoor air quality (IAQ). To support BPA in the quantification of weatherization and IAQ studies, Brookhaven will provide Bonneville and Lawrence Berkeley Laboratory (LBL), which have overall responsibility for the field program, with the measurement technology for performing air infiltration and ventilation in those homes and buildings using the Brookhaven Air Infiltration Measurement System (BNL/AIMS). BNL will provide final calculations of the air infiltration, exfiltration, and exchange rates so that proper energy audits of the consequences of the weatherization study can be performed. New modeling schemes will be developed as needed.

35027 **(DOE/CE/15240—T4) Insulated siding project: Final report.** (Ball State Univ., Muncie, IN (USA). Center for Energy Research/Education/Service). Dec 1986. Contract FG01-85CE15240. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87004321.

Research and development on the nibbed vinyl insulative siding product has been completed. The product has been tested and evaluated in response to the issues raised by the first and second stage reviewers in the OERI invention review process. The production run machine design has been completed, prototyped and evaluated and the agreement for full-scale production. Final evaluation and testing of the machine's flawless part production was integral to the manufacture and preparation of samples for purposes of final tests in the Ball State CERES laboratories.

35028 **(DOE/CE/63478—T4) Arrowhead Timber Co. appropriate forest energy technology: 1987-1991 business plan.** Baker, J.; Glowacki, J.; Jarvi, S. (Arrowhead Economic Opportunity Agency, Virginia, MN (USA)). 3 Jun 1987. Contract FG01-86CE63478. 363p. NTIS, PC A16. File Number DE87009944.

The mission of the Arrowhead Timber Company is to provide residential and light commercial customers with an opportunity to purchase and install a heating system or conversion unit that utilizes a locally produced and renewable source of energy: namely, wood pellets. Over the past year, the Arrowhead Community Economic Assistance Corporation (ACEAC) and the Arrowhead Economic Opportunity Agency (AEOA), both of Virginia, Minnesota, have conducted a trial of the proposed development plan presented in this document. This trial period has demonstrated the viability of recruiting existing small business to act as dealers for the solid fuel pellets and related products. Dealer sales to residential and light commercial energy user market segments is estimated for an area-wide network of four such dealerships based on this experience.

35029 **(DOE/CE/63480—T1) The Window Works of Boone, N.C.: A business plan.** (WAMY Community Action Agency, Inc., Boone, NC (USA)). 01 Oct 1986. Contract FG01-86CE63480. 108p. NTIS, PC A06. File Number DE87010230.

A business plan is presented for the fabrication and marketing of vinyl rigid frame windows. The market area is Boone, North Carolina. A glossary of terms is included. (BCS)

35030 **(DOE/TIC—11628) Office of Buildings and Community Systems: FY 1986 Research-in-Progress.** (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Buildings and Community Systems). Jul 1987. 39p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87006788.

This report describes the 1986 research activities of the Department of Energy's Office of Buildings and Community System (OBCS). It is one of many activities undertaken by OBCS to promote the efficient and effective transfer of its R and D findings to public- and private-sector users. The report compiled from project summaries contained in the Research-in-Progress (RIP) data base of the Office of Scientific and Technical Information, Oak Ridge, Tennessee. A total of 159 abstracts are provided for research being performed in the following (OBCS) subprograms: Buildings Systems; Technology and Consumer Products; Appliance Standards; Community Systems; and Analysis and Technology Transfer. (BCS)

35031 **(LBL—18698) The residential hourly and peak demand model: Description and validation.** Verzhbinsky, G.; Ruderman, H.; Levine, M.D. (Lawrence Berkeley Lab., CA (USA)). Dec 1985. Contract AC03-76SF00098. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010371.

This paper describes the construction and validation of the residential hourly and peak demand model and investigates the accuracy of the model by comparing the model's predictions with utility data. The first section provides an overview of the model

structure and describes the sources of data and the adjustments needed for a specific utility service area. It is followed by a section on model validation in which a comparison is made between the results of the model and the residential loads in the Detroit Edison service area. The conclusions of the study are presented in the final section.

35032 **(LBL—22360) Magnetic enhancement of ultraviolet radiation efficiency of low-pressure Hg-Ar discharge.** Zhou, T.M.; Wang, L.Z.; Hollister, D.D.; Berman, S.M.; Richardson, R.W. (Lawrence Berkeley Lab., CA (USA)). Jul 1986. Contract AC03-76SF00098. 15p. (CONF-8608179—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010280.

From Annual Illuminating Engineering Society conference; Boston, MA, USA (16 Aug 1986).

Application of an axial magnetic field has been found to enhance the efficiency of production of resonance radiation in a low-density Hg-Ar discharge. A specialized experimental system was developed to study this effect, and a maximum efficiency increase of about 7% was observed at B = 530 gauss. The temperature for peak efficiency was observed to shift to higher temperatures in the presence of the magnetic field, as predicted by Richardson and Berman.

35033 **(NP—7752439) Energy conservation by means of reflective coatings. Final report.** Binder, K.; Grasenick, F.; Hoerl, E.; Kremnitzer, P.; Ruedenauer, F.; Schaffar, G.; Semerad, E.; Steiger, W.; Viehboeck, F. (Oesterreichische Gesellschaft fuer Vakuumtechnik, Seibersdorf). Nov 1985. 220p. (In German). NTIS (US Sales Only), PC A10/MF A01. File Number DE87752439.

The publication gives a survey of possible ways and measures of energy conservation using spectrally selective reflecting materials. Combined with suitable heating and insulation techniques technologies such as these may both improve the effective thermal insulation of buildings and help to reach a comfortable thermal radiation all over at relatively low wall temperatures. Based on a discussion of general ways and measures of conserving energy (windows, annealed window panes, interior walls and accessory interior fittings and decoration such as jalousies, blinds and curtains) the publication deals with the quantification of commercial products (base materials for reflective foils, optical qualification of window foils and wallpapers, layers of reflective window foils, mechanical qualification), aging due to light radiation (changes in the mechanical and optical properties and chemical composition), the technical effectiveness of windows, stairs, exterior components (coatings) as well as with cost-benefit analyses and the fabrication of test layers (selection of materials, product engineering, testing methods, properties, chemical composition). The final chapter is devoted to results obtained from patent searches. (HWJ).

35034 (NP—7752440, pp 102-104) **Heat pumps and their impact on the environment.** Knoflacher. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Umweltforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The report demonstrates the principle of heat-pump heating, possible energy sources, methods of heat production and energy conservation, the ecological significance of heat sources and the environmental impact of heat pump systems both in normal operation and in disturbed operation to provide the basis for the environmental impact testing procedure. (orig./MOS).

35035 **(NZERDC-P—87) Air tightness levels in Auckland and Christchurch homes.** (Synergy Applied Research Ltd., Wellington (New Zealand); New Zealand Energy Research and Development Committee, Auckland). Jan 1986. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900747.

The air tightness of a sample of 55 houses less than 5 years old (30 in Christchurch, 25 in Auckland) was measured using the depressurization technique with equipment developed by the Building Research Association of New Zealand. The results of the survey are combined with data from a previous study of 26 houses in the Wellington area to give air tightness results characteristic of approximately 30% of the New Zealand housing stock or approximately 50% of houses within the 0 to 20 years age group. The air tightness of houses less than 5 years old falls in the range 5 to 16 air changes per hour at 50 Pa and the mean value is 9.7 ac/h. No important differences due to geographical region or external cladding type were discovered, although the complexity of the building type was found to correlate with air tightness.

35036 **(PNL—5892) Household energy conservation attitudes and behaviors in the Northwest: Tracking changes between 1983 and 1985.** Fang, J.M.; Hattrup, M.P.; Nordi, R.T.; Shankle, S.A.; Ivey, D.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010612.

Pacific Northwest Laboratory (PNL) has analyzed the changes in consumer energy conservation attitudes and behaviors in the Pacific Northwest between 1983 and 1985. The information was collected through stratified random telephone surveys on 2000 and 1058 households, respectively, for 1983 and 1985 in the Bonneville Power Administration (BPA) service area in Idaho, Oregon, Washington and Western Montana. This report covers four topic areas and tests two hypotheses. The topics are as follows: consumer perceptions and attitudes of energy use and conservation in the home; consumer perceptions of energy institutions and other entities; past and intended conservation actions and investments; and segmentation of homeowners into market prospect groups. The hypotheses tested are as follows: (1) There has been no change in the size and psychographic make-up of the original three market segments found in the 1983 survey analysis; and (2) image profiles of institutions with respect to familiarity, overall impression, and believability as sources of energy conservation information remain unchanged since 1983.

35037 **(PNL—5905) Financing residential energy conservation investment in the Northwest, 1985.** Fang, J.M.; Hattrup, M.P.; Nordi,, R.T.; Ivey, D.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010577.

Pacific Northwest Laboratory (PNL) has analyzed how households in the Pacific Northwest financed their investments in energy conservation measures during the 1983-85 period, how they would finance their likely future investments, and related topics regarding conservation investments and financing. The information was collected through a stratified random telephone survey of householders conducted in October/November 1985 in the Bonneville Power Administration (BPA) service area in Idaho, Oregon, Washington and Western Montana. This information will be used by BPA to facilitate the planning, design, and implementation of relevant conservation programs such as the Residential Weatherization Program, and potential programs of bank and utility loans.

35038 **(PNL—6111) 1985 consumer segmentation: Assessment of the market for conservation in the Northwest: Phase 2.** Bailey, B.M.; Hattrup, M.P.; Nordi, R.T.; Shankle, S.A.; Ivey, D.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 207p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010613.

This report presents information on consumer attitudes toward conservation, past and intended conservation behaviors, and utility-sponsored conservation program participation levels. The information was collected by means of random telephone surveys of households in Idaho, Oregon, Washington, and Western Montana. Pacific Northwest Laboratory (PNL) conducted analyses of the survey results for the Bonneville Power Administration (BPA) to obtain a better understanding of consumer attitudes and behaviors and to facilitate conservation program planning, design, and marketing.

35039 **Monitored energy performance of new and retrofitted buildings: Results from the "BECA" data compilations.** Harris, J.P.; Meir, A.K.; Busch, J.; Gardiner, B.L.; Goldman, C.A.; Greely, K.; Piette, M.A.; Riley, R.; Usibelli, A. (Buildings Energy Data Group, Bldg 90-H, Lawrence Berkeley Lab. (LBL), Univ. of California, Berkeley, CA 94720). pp 3210-3217 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—). Contract AC03-76SF00098.

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

Hundreds of millions of dollars have been invested by government, utilities, and private building owners in efforts to improve building energy efficiency. However, until recently there has been no single source of well-documented data on the actual energy savings that have occurred and the cost of achieving them. The "Buildings Energy-Use Compilation and Analysis" (BECA) data base at LBL compiles and analyzes measured data on the performance and cost-effectiveness of energy-saving technologies in residential and commercial buildings. This paper summarizes recent results and some implications for research and policy. Results from over 350 new, low-energy residences show average heating energy loads, corrected for weather and inside temperatures, at about 30-50% of the level required by conventional new U.S. houses. Retrofitted single-family houses and multifamily buildings achieve weather-corrected savings averaging 20-25%, with 5-7 year simple paybacks.

35040 **A review of ventilative cooling for hot-humid climates.** Chandra, S.; Fairey, P.W. III; Keresteciogiu, A.A. (Florida Solar Energy Center (FSEC), 300 State Road, 401 Cape Canaveral, FL 32920). pp 3141-3149 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—).

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

For the past several years the authors have researched the integration of ventilative cooling and air conditioning. This paper summarizes the results of several tasks: i) development of test procedures to evaluate innovative ventilator designs, ii) integration of wingwall designs in schools and residences, iii) development of innovative ventilators, iv) integration of ceiling fans and ventilative cooling, v) prediction of airflow through apertures, vi) measurement of convective heat transfer in naturally ventilated rooms, and vii) prediction of energy savings from ventilative cooling accounting for humidity effects.

35041 **Decentralized electric fuel cell powered house using co-generation and hybrid operation for potential low cost.** Wilhelm, W.G. (Office of Technology Transfer, Brookhaven National Lab., Upton, NY 11973). pp 3387-3394 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—).

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

A novel, decentralized, electric power co-generation system experiment for residential application is under investigation at Brookhaven National Laboratory (BNL). This system concept is based on hybrid operation using a small fuel cell (less than 1000 watts) in combination with electric battery storage located in most of the appliances. The house uses 24 volt direct current with no alternating current conversion or connection to the electric power grid. The standard house wiring is used with load leveling provided by "intelligent" charging electronics located in the appliances. The system is easily adapted to a number of renewable energy inputs so that alternative "fuel" options can be applied as required. The thermal component from the fuel cell will be applied to tempering water in a storage tank prior to heating for domestic use.

35042 **Energy conserving drain-back heating and cooling system using polymer material construction.** Wilhelm, W.G. (Office of Technology Transfer, Brookhaven National Lab., Upton, NY 11973). pp 3371-3377 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—).

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

This paper describes an hydronic heating and cooling system in an atmospheric pressure. The system is designed for multi-zone operation using a tall, wall mounted, thin polymer film heat-exchanger capable of space heating and cooling. Water is passed through the heat-exchanger panel through a special top header that distributes the water between two stressed films for complete wetting. Water exits at the bottom of the panel under the influence of gravity to a polymer return line. The heat-exchangers are primarily convective with a radiant component that can be adjusted for maximum comfort.

35043 **Cooperative indoor air quality research between government and industry - A Minnesota case study.** Lane, C.A.; Woods, J.E. Jr. (Minnesota Dept. of Energy and Economic Development, St. Paul, MN 55101). pp 3245-3251 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—).

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

Energy efficient buildings and acceptable indoor air quality can coexist, but technical relationships between the two are complex and challenging. This situation mandates improved coordination of research efforts by government, institutions and industry. This paper reports on a coordinated research strategy between the Minnesota Department of Energy and Economic Development and Honeywell Physical Sciences Center. The goal is development of HVAC control systems to provide indoor air quality without compromising energy conservation in residential buildings. The research effort develops HVAC control strategies which will improve marketing of energy conservation to the building community. This requires a carefully coordinated effort between government programs and industry marketing efforts to provide effective technology transfer to the building community.

35044 **Dynamic simulation of whole building systems.** Park, C.; Clark, D.R.; Kelly, G.E. (Center for Building Technology, National Bureau of Standards, Gaithersburg, MD 20899). pp 858-868 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—).

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

In an effort to study the dynamic performance of whole building systems, a non-proprietary building systems simulation program called HVACSIM/sup +/ has been developed at the National Bureau of Standards (NBS). The program HVACSIM/sup +/, which stands for HVAC SIMulation PLUS other systems, is capable of modeling the dynamic interactions between the HVAC system and other building systems, including the building shell, the control system, the heating/cooling plant, and a building management system. Information is presented on the architecture, capabilities, numerical methods, and component models used in the current version of HVACSIM/sup +/ and on its application to the simulation of whole buildings. An example simulation is presented to illustrate the use of HVACSIM/sup +/ in analyzing the dynamic performance of a three zone building.

35045 **A field evaluation of daylighting system performance.** Benton, C.; Warren, M.; Selkowitz, S.; Verderber, R.; Mc Bride, J.; Morse, O. (Applied Science Div., Lawrence Berkeley Lab., Berkeley, CA 94720). pp 3114-3121 of CID '86: Advancing building technology. Washington, DC; United States National Committee for CIB (1986). (CONF-860901—). Contract AC03-76SF00098.

From 10. CIB congress on advancing building technology; Washington, DC, USA (21 Sep 1986).

This paper describes the performance of a 56,000-m/sup 2/ office building emphasizing the use of daylighting for ambient illumination. Natural light serves 3,000 employees in open-plan offices through the building's five floors. The architectural scheme includes ceilings that slope from 4.25 m (perimeter) to 2.75 m (center), 3.5-m-deep light shelves at the exterior walls, and a central atrium providing light to interior spaces. An electric lighting system supplements available daylight, when necessary, using fluorescent fixtures with continuously dimming ballasts controlled by photocells. Monitoring during a one-year period has confirmed that the daylighting elements of the building provide ambient illumination in a pattern predicted by the design studies. Between 8AM and 6PM on an average summer day, the building's southern half can potentially maintain the target illuminance of 350 lux with an electric lighting load of 44% full power. The northern half of the building would require less electrical lighting at 31% of full power.

35046 **The design of energy-responsive commercial buildings.** Ternoey, S.; Bickle, L.; Robbins, C.; Busch, R.; Mc Cord, K. New York, NY; John Wiley and Sons Inc. (1985). 370p. John Wiley and Sons Inc., 605 Third Avenue, New York, NY 10150.

This book is a practical guide for building designers who want to reduce the nonrenewable energy needs of commercial and institutional buildings. The book presents, compares, and interprets the most current information on the principles, advantages, and disadvantages of many energy-related design alternatives. Topics considered include reviewing and interpreting our collective learning experience, the range of possible solutions, energy-responsive climate-rejecting buildings, energy-responsive climate-adapted buildings, the range of possible design approaches, a framework for design, a recommended design approach, applying the recommended design approach: examples, the financial value of energy-responsive design, building energy analysis during early design stages, and component energy analysis during early design stages.

35047 **Restaurant energy performance.** Mazzucchi, R.P.; Claar, C. (Battelle Pacific Northwest Lab.). pp D90-D102 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC06-76RL01830.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

End-use energy consumption data has been acquired at fifteen minute intervals for seven restaurants since July 1, 1983. Concurrent measurements of on-site weather conditions, internal temperatures, and meal or customer counts have been recorded as well. This paper reviews the project methods and provides heretofor unavailable insight of restaurant energy usage and performance. Data have been summarized to reveal the quantities of electricity and natural gas consumed for food preparation, sanitation, refrigeration, lighting, and heating ventilation and air conditioning. This paper provides an assessment of the variability of these quantities across the various sites considering building characteristics, weather, and the level of food service activity. HVAC energy use is found to be highly correlated to exterior temperature, but, variation of total energy use is relatively insensitive to levels of food service activity.

35048 **Development of a data base on end-use energy consumption in commercial buildings.** Heidell, J.A. (Battelle, Pacific Northwest Lab.). pp D49-D62 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC06-76RL01830.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

Battelle, Pacific Northwest Laboratory, has completed a comprehensive inventory of end-use metered data in commercial buildings constructed using typical design practices. This paper summarizes the results of the inventory and the examination of the types of data measurements desired by building researchers. The inventory and the definition of data needs are used to develop an assessment of end-use data on existing commercial buildings and to determine the need for a public domain data base. This inventory represents the most thorough review of end-use data collected to date. The results are summarized by the types of end-uses collected, the data collection method, the time resolution of the data, the availability of the data, related supporting data, and sources of existing documentation. Supporting data reviewed include: building construction details, building operation characteristics, occupancy characteristics, occupancy information, and microclimate data.

35049 **Effects of utility incentive programs for appliances on the energy efficiency of newly purchased appliances.** Dickey, D.; Levine, M.D.; McMahon, J.E. (Lawrence Berkeley Lab.). pp I61-I75 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC03-76SF00098.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

Rebates are the new forms of financial "carrots" that have been developed to influence purchase decisions of residential customers. The novelty of utilities' provision of "up-front cash" to home owners who select particular appliances has captured the interest of consumers, utilities, and regulatory bodies. State public utility commissions have encouraged (and in some case, have required) these efforts. Commissions and state legislatures have determined that utilities' direct subsidy of customers' appliance purchasers have been justified because they provide energy at a lower cost than investment in new generating capacity or purchase of expensive peaking fuels.

35050 **The residential energy consumption of low-income and elderly households: A summary of findings from Decatur, Illinois.** Brown, M.A.; Rollinson, P.A. (Oak Ridge National Lab.). pp H5-H16 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC05-84OR21400.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

The energy literature is replete with opinions that the poor and elderly have cut their residential energy consumption to a minimum. This paper challenges such conclusions through an analysis of data on a sample of 319 Decatur, Illinois homeowners. The data include utility bill histories and survey information on housing characteristics, energy-related behaviors, attitudes, and socio-economic and demographic characteristics. The analysis shows that residential energy consumption per square foot of living space is significantly higher for the elderly and poor than for other groups of Decatur homeowners. By breaking energy use into seasonal components, the paper estimates consumption for various household uses. This information, combined with the survey data, suggests that both subgroups heat and cool their homes inefficiently, due in part to the conditions of their homes, but also due to energy-related behaviors.

35051 **Energy conservation in public housing: The San Francisco experience.** Goldman, C.; Ritschard, R.; Atkielski, R. (Lawrence Berkeley Lab.). pp H48-H62 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC03-76SF00098.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

The San Francisco Housing Authority, like many other public housing authorities, has faced rising energy costs in recent years. Approximately 23 percent of the Authority's /20 million 1983 operating budget was used to provide gas and electricity for the nearly 7000 conventional public housing apartments that it managed. In 1982, the Authority began installing specified energy conservation measures financed under a zero interest loan program (ZIP) from the local utility company. The retrofit measures includ-

ed attic insulation, exterior door weatherstripping, low-flow showerheads, and water heater blankets. By the end of 1983, 4082 apartments (59 percent of the Authority's units) had been weatherized at a cost of approximately $396,000. The authors analyze three years of metered gas consumption data, including one year of post-retrofit data, for five family housing projects (totalling 1980 units) in an attempt to determine energy savings attributable to the retrofits. Post-retrofit energy consumption levels are 7 to 20 percent lower in the four projects that saved energy. In the fifth project, annual energy use increased by 14 percent. Overall, the Housing Authority's recent retrofit efforts in the five projects are cost-effective, with an average simple payback of 4.6 years and a cost of conserved energy of /2.50/MBtu. The Housing Autority's efforts to retain tight budgetary control over retrofit costs, which averaged only /150/unit, contributed to the program's success.

35052 **Saving energy the easy way: An analysis of thermostat management.** Vine, E. (Lawrence Berkeley Lab., Berkeley, CA). pp F219-F231 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—).

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

The author analyzed data on self-reported winter and summer thermostat settings and control strategies that were collected in recent surveys by utility companies, and state and federal energy agencies. He constructed several hypotheses to examine how thermostat behavior was related to conditions internal and external to the occupants: socioeconomic characteristics of occupants (age, education, income, home ownership, and race), building characteristics (house type, size, and age), space conditioning fuel and system, climate, and energy audits. He also examined thermostat management during the day (time-of-day) and over time and analyzed its relationship to energy use. He found that thermostat behavior (especially during the summer) was not fixed, but varied and was sensitive to some conditions.

35053 **Energy use among the low-income elderly: A closer look.** Diamond, R.C. (Lawrence Berkeley Lab., Berkeley, CA). pp F52-F66 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—). Contract AC03-76SF00098.

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

Detailed examination of eighteen months of utility bills for each unit in the project shows wide variation (on the order of 10-1) in both summer and winter. Because the authors found little correlation between energy use and climate, construction quality, and thermostat settings, he examined additional behavioral and attitudinal data collected from interviews for clues to the large variations observed. Factors affecting the energy used by individual residents as well as by groups of high and low users are presented. Differences in the resident's health and comfort, the level of satisfaction with the heating/cooling system, the degree of understanding and control exercised, attitudes toward conserving, and income and status, all appear to be variables underlying the wide divergence in energy usage.

35054 **Interest in residential peak leveling electric rates.** Elworth, J.T.; Doob, L.W. (Battelle Seattle Research Center). pp F67-F79 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—).

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

An experiment was performed in which five different communications concerning time-of-use (TOU) or peak reducing electricity rates were sent to a sample of 4,893 Massachusetts homes. It was found that people are receptive to the concept of TOU rates based on their attitudes and the number of appliances that can be switched to off peak hours; as measured by the number of post-cards returned, communications emphasising both global and economic concerns were more effective in recipients remembering the communications and their familiarity with TOU rates than economic concerns alone; the control communication was more effective due to a description of disadvantages of TOU rates than the communication with a question format and an emphasis on economic gain after which the control was, in part, designed.

35055 **Statistical analysis of lifestyle factors in heating energy use of new and weatherized Minnesota houses.** Fagerson, M.H. (Minnesota Dept. of Energy and Economic Development). pp F93-F105 of Proceedings of the ACEEE 1984 summer study on energy efficiency in buildings. Washington, DC; American Council for an Energy Efficient Economy (1984). (CONF-840819—).

From ACEEE meeting on energy efficiency in buildings - doing better: setting an agenda for the second decade; Santa Cruz, CA, USA (14 Aug 1984).

This study analyzes relationships of building characteristics and occupant lifestyle to the heating energy use of each house and to the variations in energy use by nominally identical houses. The results indicate that only about one third of the variation in heating energy use of nominally identical houses can be explained by the variables examined. The unexplained variation may be due to variations in the houses which result in houses not being truly identical, to lifestyle factors which have not been examined or to imprecise measurement of the variables included in the study. It appears that both the lifestyle and the design of the house can cause variations in energy use among identical houses. And that the design of the house can determine which lifestyle factor will have the most influence on the energy use of the house. Finally, lifestyles may be somewhat dependent on the design and construction of the house.

3202 Transportation

REFER ALSO TO CITATION(S) 34540

35056 **(PB—87-161402/XAB) Michigan small-transit-system management handbook. Final report.** (Michigan Dept. of Transportation, Lansing (USA)). Dec 1985. 276p. NTIS, PC A13/MF A01.

The handbook is designed to provide a basis for instituting, organizing, and maintaining small-transit systems. It is a practical guide to management, with detailed information about the many responsibilities and tasks facing actual or prospective managers of transit systems in small cities or rural counties. Management issues addressed include operations, personnel, maintenance, equipment, marketing, and evaluation. Although the handbook is directed specifically to Michigan's statewide public-transit program, much of it can be applied in other states.

35057 **(PB—87-168597/XAB) Manual for planning, designing, and operating transitway facilities in Texas. Chapter 4. Transitway surveillance, communications, and control. Research report (Final), September 1983-October 1986.** McCasland, W.R.; Stokes, R.W.; Mounce, J.M. (Texas A and M Univ., College Station (USA). Texas Transportation Inst.). Oct 1986. 83p. (TTI—2-8-10-84-425-2F). NTIS, PC A05/MF A01.

See also PB—87-136958.

Transitways are exclusive, physically separated, limited access roadway facilities for high-occupancy vehicles (buses, vans, carpools). The complexity of operations, (reversible flow) and, in many applications, the restrictions to cross-section width, emphasizes the need for an active traffic-operations management system which includes capabilities for surveillance, communications, and control. The importance of coordinating Surveillance, Communications and Control (SC&C) considerations with both the planning and design processes for transitways cannot be overstated. Operation of a transitway is critical and should be considered early in the design phase. This report addresses Transitway Surveillance, Communication, and Control as Chapter 4 of the previously prepared Manual for Planning, Designing and Operating Transitway Facilities in Texas (Research Report 425-2F). This chapter of the manual presents information for assessing the need for SC&C sys-

tems on transitways, describes the basic concepts, systems, and technologies associated with SC&C, outlines some general guidelines for selecting the appropriate SC&C system, and provides criteria for the actual design of a SC&C system.

35058 **(PB—87-170163/XAB) Urban decision making for transportation investments: Portland's light-rail transit system. Final report.** Edner, S.M.; Arrington, G.B. (Portland State Univ., OR (USA)). Mar 1985. 103p. NTIS, PC A06/MF A01.

This report is a detailed case study of the various decisions which led to the investment in Portland, Oregon's light-rail transit system. The study reviews the alternatives that were considered, the factors that led to the choices made, and the impacts and secondary effects the choices triggered. Topics discussed include the withdrawal of the Mount Hood Freeway, the substitution of transit and the options considered, the changing political infrastructure that affected decision making, citizen participation in the process, financing of the system, involvement of the private sector downtown, and the actual building of the light-rail line. The report should be of special interest to staffs of local officials involved in making major transportation investment decisions.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 34511, 34722, 34771, 34807, 34808, 34809, 34997, 35076, 35131, 35327, 35367, 35430

35059 **(AD-A—178995/7/XAB) Evaluation of used automotive oil cofiring practices for compliance with used-oil regulations and environmental-quality requirements. Report for September 1985-March 1986.** Robinson, M.A. (Naval Surface Weapons Center, Dahlgren, VA (USA)). May 1986. 38p. (NSWC-TR—86-89). NTIS, PC A03/MF A01.

Cofiring of used automotive oil in Navy boilers was examined with regards to used-oil regulations and environmental impact. Air-dispersion modeling of a boiler cofiring used automotive oil was also performed.

35060 **(ANL—86-53) Tube vibration in industrial size test heat exchanger (pitch-to-diameter ratio 1.42).** Halle, H.; Chenoweth, J.M.; Wambsganss, M.W. (Argonne National Lab., IL (USA)). Dec 1986. Contract W-31109-ENG-38. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011003.

Continuing an ongoing experimental program, typical industrial shell-and-tube heat exchanger configurations were investigated systematically for the occurrence of potentially damaging tube vibration as a function of flowrate. Results from shellside water flow tests of nine additional exchanger configurations are reported. Eight test cases covered tube bundles with four different triangular and square layouts with a pitch-to-diameter ratio (P/D) of 1.42 to provide comparison with previous P/D = 1.25 tests. Two baffle edge orientations were tested. An additional test case involved a design fix. The testing focused on identifying the lowest critical flowrates that initiate fluidelastic instability and/or large amplitude tube motion, and finding the location within the bundle of the tubes where these responses were first experienced. The threshold flowrates were determined by a combination of methods based on sensory observations, vibration amplitude data, and frequency response information. Instability criteria were preliminarily evaluated. Overall shellside pressure drop and incremental pressure drops across sections of the exchanger are reported for all configurations.

35061 **(DOE/BP/18945—T6) Energy conservation in the food industry: Van de Kamp's Dutch Bakery.** (United Industries Corp., Bellevue, WA (USA)). Jan 1985. Contract AC79-84BP18945. 116p. NTIS, PC A06. File Number DE87011165.

This report presents the results of an energy study that was conducted at Van de Kamp's Dutch Bakery in Seattle, Washington. Van de Kamp's is one of five food industry (SIC 20) plants that are being studied. The project tasks involve developing analysis procedures for energy conservation measures (ECM's); conducting energy analyses at five food industry plants; and reporting the results of the analyses to plant managers and BPA officials.

35062 **(DOE/BP/18946—T2) Electrical energy conservation analysis of the wood products (SIC24) industry in the BPA Service District: Follow-up survey report.** (URS/TransEnergy Systems, Seattle, WA (USA)). 30 Jul 1986. Contract AC79-84BP18946. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011167.

This report presents a summary follow-up survey to an Electrical Energy Conservation Analyses of five Wood Products Industry (SIC 24) mills in the Bonneville Power Administration (BPA) Service District. This contract included a requirement for resurvey of the five mills to determine the extent, if any, of implementation of the electrical conservation measures identified. The five mills surveyed and analyzed were: Pope and Talbot, Port Gamble, Washington; Pope and Talbot, Oakridge, Oregon; Champion International, Rosenburg, Oregon; Champion International, Bonner, Montana; and Northwest Hardwoods, Centralia, Washington.

35063 **(DOE/CE/15231—T5) [Method and means for preventing frost damage to crops]: Project status report, [January 1 through April 30, 1987].** Reich, D.R. (Reich (Douglas R.), North Fort Myers, FL (USA)). 26 May 1987. Contract FG01-85CE15231. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009862.

An improved version of the Reich Heater Prototype has been redesigned and fabricated. The test facilities have been modified. A production model of the Reich heater has been designed. Its commercialization is underway. (DLC)

35064 **(DOE/CS/40378—1) Energy integrated swine farm system in Nebraska: Final report.** Splinter, W.E.; Schulte, D.D. (Nebraska Univ., Lincoln (USA); USDOE Idaho Operations Office, Idaho Falls). May 1987. Contract FC07-80CS40378. 116p. NTIS, PC A06. File Number DE87010949.

One of the guidelines used to establish the Energy-Integrated Farm System (EIFS) was that it be representative of Midwest agriculture. Sales of irrigated crops and hogs in Nebraska generate over 50% of the state's revenue. Thus, an irrigated crop and wine farm was chosen for demonstration. The concept of this project involved the use of "state-of-the-art" technology in an attempt to achieve zero flow of direct and indirect petroleum input into the farming operation. Specific objectives were: utilization of energy-saving irrigation scheduling and low-pressure center-pivot and gated-pipe irrigation systems; use of 190 proof ethanol produced from sweet sorghum as a replacement for fuel in farm engines; reduced tillage and fertilizer usage for energy, soil and water conservation; development of solar energy and methane gas usage in an integrated fashion for electricity production and for hot-water and space heating in a swine-production facility; use of mini- and micro-computer technology for on-farm energy conservation and management; recovery of waste heat and carbon dioxide from alcohol fermentation and swine production for greenhouse production of vegetables; demonstration of natural air grain drying, use of windbreaks, and other energy conservation practices; and determination of the economic feasibility of energy integrated farming for swine and irrigated crop production. A new farm was constructed to achieve these objectives. This report describes the system, its components and gives an economic analysis.

35065 **(DOE/ID—10167) Energy integrated farm system technical summary report.** Breckenridge, R.P.; Price, D.R.; Sherwood, R.K.; Thompson, W.N. (USDOE Idaho Operations Office, Idaho Falls). Mar 1987. Contract AC07-76ID01570. 50p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87010742.

The Energy Integrated Farm System program was established by the Department of Energy in 1980 in response to the hardship imposed on US farmers by high fuel costs and unreliable fuel supplies. The program investigated the feasibility of integrating energy conservation practices with on-farm energy production to reduce farm energy consumption and make farms more energy self-sufficient. Seven farms located in various geographical regions in the US and Puerto Rico participated in the program. Each of these farms developed an energy integrated farm system project that used a unique combination of energy production and energy conserva-

tion methods to supply energy to the farm and reduce the farm's dependence on energy produced from nonrenewable sources such as coal and oil. Methods used at these projects included conservation tillage, solar heating, waste heat recovery, methane digestion, electricity production from biogas, alcohol fuel production, fluidized-bed combustion of crop wastes, and computer-aided conservation irrigation. This report is a summary of the seven technical manuals prepared at the conclusion of the projects. It presents highlights and results, provides an overview of successes and problems, and lists recommendations.

35066 **(DOE/ID—10169) Critical review of the Office of Industrial Programs': Aluminum Research Program.** Pritchett, T.R.; Adkins, E.M.; Agarwal, J.C.; Hackerman, N.; Kaufmann, T.D. (EG and G Idaho, Inc., Idaho Falls (USA); USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Industrial Programs). May 1987. Contract AC07-76ID01570. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011042.

The Department of Energy's retrofit cermet anode and TiB_2 cathode R & D program has the potential to significantly reduce US energy consumption in the next five to ten years. The chance of successful commercial implementation has been estimated by DOE consultants and the Critical Review Panel to be greater than 50% based on recent promising test results. Estimated savings of energy, labor, and materials offset the added cost of the new materials so that retrofit by primary aluminum producers would be economically well justified. Therefore, the Critical Review Panel recommends a three-phase approach to complete and necessary research, perform proof of concept tests, and provide technical assistance for commercial adaptation. Private industry should actively participate with the Department of Energy to establish the technical and practical feasibility of these new materials to assure implementation by primary aluminum producers within the next ten years.

35067 **(Juel—2057) Investigations on the treatment of pig manure in algal ponds.** Groeneweg, J. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Biotechnologie; Essen Univ. (Gesamthochschule) (Germany, F.R.)). Apr 1986. 260p. (In German). NTIS, PC E17; Available from NTIS as TIB/B87-05912.

Due to the increasing numbers of animals per farm and the density of farms in some areas the amounts of manure produced locally exceed by far the agricultural needs. Overfertilization causes pollution of ground-water (nitrate-enrichment) and surface waters. The use of high-rate-algal ponds for the treatment of excess wastes from live-stock production units offers a possibility to reduce environmental damage to a large extend. Data are presented on the influence of copper sulfate used as a growth promoter in pig diets on the growth of microalgae in laboratory cultures. Mathematical models are applied for estimating algal growth. The outcome of outdoor experiments to treat piggery waste with algal-bacterial-systems under the climatic conditions given in Northrhine-Westphalia (Germany) is reported. Special attention is given to the fate of nitrogen, the potential of the photosynthetic oxygenation and the stability of the microalgae population. Prior to treatment in HRAP, solids were separated by sieving and the pig slurry diluted. By adapting retention times and loadings to the mean prevailing global radiation values and temperatures, enough oxygen was produced from April to October to treat approx. 1400 m^3 (N-conc. 5 kg m^3) liquid slurry per hectare pond surface (COD-reduction 80%, BOD-reduction up to 96%). Total albazod (algae-bacteria-zooplankton-detritus) yield is approx. 30 tons of dry matter, which means that 2400 kg of nitrogen can be recycled as a protein-rich feed.

35068 **(PB—87-166245/XAB) Overview of hazardous/toxic waste incineration.** Lee, C.C.; Huffman, G.L.; Oberacker, D.A. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). 1986. 12p. (EPA—600/J-86/281). NTIS, PC A02/MF A01.

Pub. in Jnl. of Air Pollution Control Association, Vol. 36, No. 8, 922-931(Aug 1986).

Effective hazardous/toxic waste disposal and safe dumpsite cleanup are two of EPA's major missions in the 1980s. Incineration has been recognized as a very efficient process to destroy the hazardous wastes generated by industry or by the dumpsite remediations. The paper provides an Incineration Summary ranging from discussion of broad regulatory and permitting requirements through more detailed descriptions of typical incineration processes and monitoring techniques.

35069 **(PB—87-166286/XAB) Optimization of treatment plant operation.** Kugelman, I.J.; Houthoofd, J.M. (Environmental Protection Agency, Cincinnati, OH (USA)). Jun 1986. 5p. (EPA—600/J-86/234). NTIS, PC A02/MF A01.

Pub. in Jnl. Water Pollution Control Federation 58, No. 6, 527-529(Jun 1986); See also PB—86-118486.

This article is a literature review of articles published in 1985 that related to the operation of wastewater-treatment plants. Topics covered included management, operation, maintenance, training, process control, modeling, instrumentation, automation, and energy savings. Fifty-two references are cited.

35070 **(PB—87-173399/XAB) Energy and US agriculture: state and national fuel-use tables, 1978, 1980, and 1981. Staff report.** Torgerson, D.; Duncan, J.H.; Dargan, A. (Economic Research Service, Washington, DC (USA)). Mar 1987. 193p. (AGES—861121). NTIS, PC A09/MF A01.

The report contains estimates of energy use in U.S. agriculture for 1978, 1980, 1981. The estimates reflect information from the 1978 Census of Agriculture, the 1980 Farm Production Expenditure Survey, and the Firm Enterprise Data System for 1978. Energy-use estimates for 1981 are based on that year's crop production and invested energy data, using 1980 updated fuel-use coefficients. State energy-use estimates are summarized by type of farm operation under the two primary agricultural categories, crops and livestock. Total energy use in U.S. agriculture increased 7% from 1974 to 1978, and declined 2.4% from 1978 to 1980. In the latter period, direct energy use in on-farm production decreased 10%, while invested energy use increased 12%. National farm energy use from 1980 to 1981 rose only slightly, 2.7%, while invested energy use increased 3.6%.

35071 **(PB—87-179511/XAB) Cadmium removal and recovery by magnesium cementation. Technical completion report.** Gould, J.P.; Wiedeman, H.F.; Khudenko, B.M. (Georgia Inst. of Tech., Atlanta (USA). Environmental Resources Center). Jul 1986. 70p. (ERC—01-86). NTIS, PC A04/MF A01.

Also pub. as Georgia Inst. of Tech., Atlanta. School of Civil Engineering rept. No. SCEGIT-86/110.

The kinetics of cementation of cadmium by magnesium were studied in a completely mixed batch reactor at room temperature and constant mixing rate and ionic strength. The effect of pH and initial cadmium concentration on the rate of cadmium removal and reaction stoichiometry, or yield of magnesium consumed per cadmium cemented, were evaluated. At initial concentrations of up to approximately 25 mM, the reaction was found to follow apparent half order kinetics consistent with a migration control mechanism. As initial cadmium concentrations increased through this range, removal rates also increased. At approximately 25 mM, a transistion was observed to apparent first-order kinetics consistent with a diffusion-control mechanism. There was a significant decrease in removal rates as the initial cadmium concentration increased to levels of greater than 25 mM. Stoichiometry was found to become more favorable as initial cadmium concentration increased, and in some cases, less than 1 mole of magnesium was required to cement 1 mole of cadmium.

35072 **(PB—87-179743/XAB) Occurrence of transient puffs in a rotary-kiln incinerator simulator.** Linak, W.P.; Kilgroe, J.D.; McSorley, J.A.; Wendt, J.O.L.; Dunn, J.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Air and Energy Engineering Research Lab.). 1987. 14p. (EPA—600/J-87/006). NTIS, PC A02/MF A01.

Pub. in Jnl. of Air Pollution Control Association, Vol. 37, No. 1, 54-65.

This article discusses a statistically designed parametric investigation to determine which waste and kiln variables (charge mass, charge surface area, charge composition, and kiln temperature) significantly affect both instantaneous intensity and total mag-

nitude of the puffs leaving a kiln used to incinerate simple prototype plastic wastes, ranging from polyethylene to polyvinychloride. Results show the relative ease with which failure conditions are achieved, even at high excess air values and high kiln temperatures. Transient puffs leaving the kiln contain a number of hazardous compounds. Increasing kiln temperature does not necessarily decrease the puff intensity and may in fact cause an increase. However, the total mass emitted always decreases with increasing temperature. In addition, the mass, surface area, and composition of the charge are all important.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 34740, 34806, 34810, 35030, 35031, 35049, 35054, 35072, 35430

35073 **(AD-A—178061/8/XAB) Full-scale test program for a shower-wastewater-recycling system: technical evaluation. Interim report.** Scholze, R.J.; Bandy, J.T.; Jamison, D.K.; Morgan, J.A.; Ciccone, V.J. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jan 1987. 39p. (CERL-N—87/06). NTIS, PC A03/MF A01.

A shower wastewater recycling system is investigated for potential military use under conditions of limited water supply. Results are reported for laboratory tests on the proposed system. Parameters measured in the tests include those specified by the Office of the Surgeon General (OTSG) in the Interim Quality Criteria for direct reuse of water as well as several others of concern. The laboratory test results show that the wastewater-recycling system merits further investigation and development. The proposed system is compatible with existing Army facilities and equipment and is portable. Wastewater can be treated to a quality meeting OTSG standards. Several recycles are possible, with 85% of the wastewater recoverable for reuse. No harmful contaminants were detected in any of the test samples.

35074 **(AD-A—178425/5/XAB) Sulfuric-acid-regeneration waste-disposal technology. Final report, June 1985-November 1986.** Balasco, A.A.; Johnson, D.E.; Stahr, J.J.; Stevens, J.I.; Fields, M.A. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Nov 1986. 81p. (ADL-REF—54142). NTIS, PC A05/MF A01.

All U.S. Army Ammunition Plants (AAPs) having sulfuric acid regeneration (SAR) facilities use lime precipitation as the principal means of acid-wastewater neutralization. This is as an advanced system as is used in industrial practice. However, lime precipitation could not meet zero discharge of pollutants should these be promulgated for the sulfuric-acid industry. In fact it discharges a water high in soluble sulfates. Further, based on the only current experience at Radford AAP, this process is plagued with: excessive scaling, poor pH and turbididty control, and excessive maintenance and downtime. One probable cause of these difficulties is excessive water loads from the SAR plants resulting in inadequate residence time for crystal formation and settling, coupled with the inherent slowness of this chemical reaction. However, it should be pointed out there is an almost total lack of operating data on the adequacy or inadequacy of these lime-precipitation systems to meet even today's standards. Presumably because of concern at one time for soluble sulfate, two AAPs have secondary treatment: 1) ion exchange to remove the soluble calcium (Ca) and sulfate (SO_4) ions (Volunteer AAP); and 2) barium (Ba) precipitation to remove the soluble SO_4, followed by ion exchange (Joliet AAP). Secondary treatment would permit total recycle of the process water, thus achieving zero discharge; however, we question the utility of both of these systems in achieving any improvement in the total environment of the watersheds of the plants in question.

35075 (CONF-8403254—, pp 1-13) **Parallel connection of private power generation plants with the public utility networks.** Schaer, O. (Bernische Kraftwerke A.G., Switzerland). 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

This paper deals with private power generation plants i.e. aggregates consisting of a driving motor, a connected electric machine and the respective appliances for operation, safety and protection. Three-phase asynchronous generators and three-phase synchronous generators are dealt with under the aspect of connecting them in parallel to the distribution networks of public utility companies. The dangers arising in case of power failure and measures to counteract this danger are discussed, energy supply and the performance of power stations in private ownership. (HAG).

35076 (CONF-8403254—, pp 1-11) **Low-pollutant diesel oil for a cogeneration plant.** Gaegauf, C.; Zumsteg, H. (Zentrum fuer Angepasste Technologie und Sozialoekologie, Langenbruck, Switzerland). 1984. (In German). NTIS (US Sales Only), PC A07/MF A01. File Number DE87752436.

From Meeting on cogeneration in practice; Langenbruck, Switzerland (23 Mar 1984).

A fuel-oil fired cogeneration plant is the subject of this paper. In this plant studies were made on the energetic advantages of this way of using energy and on possible measures of reducing the emission of pollutants of internal combustion engines. The plant is described in detail. Further points are: energy generation, efficiency, supply profiles, safety, emissions and reduction of emissions. (HAG).

35077 (CONF-8609286—Absts., pp 5, Abstract 12) **Anaerobic treatment of sulfate containing waste water.** Rinzema, A. (Landbouwhogeschool Wageningen, Netherlands. Dept. of Water Pollution Control). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

35078 (CONF-8609286—Absts., pp 3, Abstract 13) **Trends of development in the aerobic and anaerobic waste water treatment.** Seyfried, C.F. (Hannover Univ., Germany, F.R. Inst. fuer Technische Chemie). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

35079 **(ISH—86) Municipal waste management in the Federal Republic of Germany. A comparison of typical parameters as a basis for determination of potential radiation exposure.** Mueller, M.K. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Feb 1986. 65p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-10120.

Presently about 30 million tons of municipal refuse are produced in the Federal Republic of Germany per year. About 70% of this waste is accommodated in sanitary landfills. The greater part of the remaining 30% of refuse is disposed of by incineration. In 1985 46 incineration plants were in operation in the Federal Republic of Germany. For the construction of incineration plants again only guidelines are existant. Obligatory for all plants is alone the TA-Luft, which defines the permissible concentrations of contaminants in waste air. Solid residues like slags, ashes and filter sediments may also contain high amounts of contaminants and must be disposed of carefully. Finally there are a number of waste disposal methods which have been employed to a limited extent only or are still in an experimental stage, e.g. pyrolysis, carburation, compostation, humification, etc.

35080 **(PB—87-169967/XAB) Measurement of suspended-particle, heavy-metal, and selected organic emissions at the Coventry municipal refuse incinerator.** Scott, D.W.; Woodfield, M.J.; Bushby, B.; Webb, K. (Warren Spring Lab., Stevenage (UK)). 1986. 53p. (LR—578(PA)M). NTIS, PC PC E06/MF E06.

The report, prepared by Warren Spring Laboratory (WSL) for the Department of the Environment (DoE), is one of a continuing series examining air-pollutant emissions from domestic-waste incinerators. The objectives of these investigations are to: (a) quantify emissions of selected polychlorinated organic materials, particles, and heavy metals to the ambient air; (b) identify the pathways of

these materials through the incineration system; (c) establish relationships between emissions and refuse collected in different areas; (d) assess the efficiency of the electrostatic precipitators; and (e) examine the relationship between pollutant emissions and plant operation.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 35111, 35119

35081 **(AD-A—178192/1/XAB) Tracked-vehicle fuel consumption. Final report.** (Army Test and Evaluation Command, Aberdeen Proving Ground, MD (USA)). 6 Mar 1987. 5p. (ITOP—2-2-603(1)). NTIS, PC A02/MF A01.

Supersedes Rept. no. ITOP-2-2-603(1) dated 15 May 84, AD—A143-835; Report on International Test Operations Procedure.

This document describes test procedures for evaluating the fuel efficiency of tracked vehicles under controlled operating conditions. The test data are a major source for comparisons with similar vehicles, and can also serve to predict the operational range of these vehicles during tactical missions.

35082 **(IKTM/VKM-FA—56) Investigation on the use of water-fuel emulsions in Diesel engines. Final report.** Zelenka, P. (Technische Univ. Berlin (Germany, F.R.). Inst. fuer Konstruktionslehre und Thermische Maschinen). 15 Oct 1985. 220p. (In German). NTIS, PC E15; Available from NTIS as TIB/B87-05875.

One possible improvement of the combustion properties of an internal combustion engine is the addition of water in the form of a water in oil emulsion. This produces a reduction in the emission of NO/sub x/ with a partial reduction of solid particle or soot emission. These conditions are thoroughly examined by determining the course with time of heat turnover during combustion, in order to obtain information on changes in forming the mixture and in the combustion of water-fuel emulsions. The effect of adding water to Diesel fuel was also to be examined in comparison with heavy oil mixed fuels as regards general working behaviour, the emission of NO/sub x/ and solid particle emission. Results on economy, fuel use and environmental behaviour are submitted from the experiments done on 5 different Diesel engines with different combustion processes. They refer to the engine efficiency, emission of nitrogen oxide, emission of unburnt hydrocarbons and carbon monoxide, black smoke in the exhaust, delayed ignition, combustion pressure and degree of conversion. 108 figures, 11 tables.

35083 **(NP—7770102) Reduction of pollutant emissions and fuel consumption, in particular during the warming-up phase and in the bottom power range in a fast running four-stroke diesel engine with direct fuel injection, by means of variable hot cooling.** Besslein, W. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau). 1985. 250p. (In German). NTIS (US Sales Only), PC A11. File Number DE87770102.

Variable hot cooling is characterised by the fact that the coolant temperature within a wide range of operation can be raised much higher than is usual at present, whilst it can be altered depending on output in the upper load range, in order to protect thermally critical engine components from overload. The corresponding studies were carried out on a fast-running, four-cylinder four-stroke diesel engine with direct fuel injection using ethylene glycol (boiling point above 170/sup 0/C). Details given include the structure of the test stand (experimental engine, measuring instruments), the selection of a suitable hot coolant and the results of the experiment in stationary operations and during the warming-up phase (fuel consumption, influence of special lubricating oil on fuel consumption, pollutant emissions of carbon monoxide, nitrogen oxide, hydrocarbons, aldehydes, smoke, particulate emissions and benzole-soluble contents). It was possible to reduce the warming-up phase by up to 70% and, in mass-produced water-coded engines, can lead to considerable reductions of exhaust pollutions and the mass of fuel consumed. (HWJ).

35084 **(NP—7770103) Influence of lubricant parameters on the fuel consumption of internal combustion (Otto) engines.** Pommer, W. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 7 Nov 1984. 129p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770103.

Experimental and commercial branded oils were used in studies (DKA/CEC method) on the influence of the motor oil parameters on the fuel consumption of a 2-litre OHM. The following results were obtained from short- and long-term experiments, which are described in detail; the oil parameters studied (viscosity, additives, friction modifiers, base oils, VI-improvers) had a measurable influence on the fuel consumption, in which viscosity was the decisive factor; the fuel consumption showed a linear decrease with the reduction of viscosity; the fuel economy increased as the rev speed and load increased; differences in relation to various additives became apparent only in the area of higher mixed friction; oils containing VI-improvers contributed markedly towards a reduction of fuel consumption in relation to single-grade oils; a viscose component should always be added to a thin basic oil component. (HWJ).

35085 **(NP—7770104) On the operational performance of an internal combustion (Otto) engine with the addition of catalytically-generated gas from methanol.** Dommes, K.-H. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 30 Jan 1985. 175p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770104.

When running internal combustion engines on methanol, poor cold starting and unsatisfactory driving in the warm phase are observed. The aim of this detailed study was thus to undertake the catalytic fission of methanol into combustion gases with low CO. For this purpose, special catalysts were developed. By putting in a fission gas of this type in addition to the rest of the fuel/air mixture in a methanol-fuelled internal combustion engine, an attempt was made to make the cold start easier, to improve warmed-up performance and to raise economic efficiency together with a reduction of pollutant emissions for the rest of engine operations. A report is made of the experiment set-up to solve this problem (test stand, instrumentation system), and the results are given in a summary under 7 points. It was found that the zeolite catalysts are not suitable for methanol fission and that the fission gas could not be provided for starting the engine. Nor was it possible to improve warmed-up engine performance using fission gas from a reactor heated with exhaust. It was possible to achieve satisfactory methanol fission by means of a synthesis catalyst however. (HWJ).

35086 **(NP—7770105) Accumulative fuel injection: A theoretical and experimental study of an electronically-controlled diesel fuel injection system for car engines.** Ganser, M. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 16 Apr 1984. 209p. (In German). NTIS (US Sales Only), PC A10. File Number DE87770105.

The electronically-controlled accumulative fuel injection system makes possible a choice of when to begin the fuel injection for diesel engines independently from motor influences, how long to inject and at what pressure. A system of this kind was studied theoretically and experimentally. After explaining the requirements to be demanded from such a diesel fuel injection system and the present state of development, structural and functional features of the accumulative fuel injection system are described. The auther goes into the accumulation jets and the determining dynamic processes inside the fuel injection element, and also the historical development of this type of system, the state of development, the electromagnetic circuit and the model formation of the injection nozzle. He goes on to deal with the structure and measurements with the indicator nozzle (control needle movement, vibrations), compares instrument readings with results from the mathematical model and reports on the trials of four nozzles on the test stand and on the engine to conclude. It was possible to demonstrate that controllable

combustion in the engine can be achieved by means of pre-injection. (HWJ).

35087 **(NZERDC-P—110) A feasibility study of gas injection systems for natural gas fuelled automotive engines.** Zoellner, S.A.; Raine, R.R. (Auckland Univ. (New Zealand). Dept. of Mechanical Engineering; New Zealand Energy Research and Development Committee, Auckland). Nov 1986. 94p. NTIS (US Sales Only), PC A05/MF A01. File Number DE87900741.

The report evaluates the feasibility of developing a natural gas injection system for automotive engines and outlines the research involved. After reviewing current petrol injection systems, the potential for adapting some of the principles and components of these to gas injection is discussed. A programme of research is suggested, which is oriented towards four systems with increasing sophistication: a controlled mixer-regulator-system, a manifold injection system with a single injector as well as with one injector per cylinder, and a system which injects directly into the combustion chamber. The need for new engine sensors, more suited to the conditions in New Zealand, is established. Problems in metering mass quantities of gas accurately may have to be countered by increased expense for electronics and control strategies (e.g. adaptive learning control). 37 refs., 42 figs.

35088 **Swirl center precession in engine flows.** Arcoumanis, C.; Hadjiapostolou, A.; Whitelaw, J.H. Warrendale, PA; Society of Automotive Engineers (1987). 14p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).
870370.

The origin and development of swirl center precession in engine flows has been investigated in a steady flow rig, with and without a porous plate simulating a stationary piston, and in a model engine motored at 200rpm; swirl, in all cases, was generated by means of 60° vanes located in the axisymmetric inlet port. The swirl center performs a helical motion that originates as an instability in the forced-vortex core from its interaction with the axial flow at a free stagnation point and develops in the engine from the piston towards the cylinder head; an opposite trend has been observed in the steady flow case with the open-ended cylinder. In the ensemble-averaged measurements, swirl center precession has been identified by the increased tangential velocity fluctuations around the off-centre zero swirl velocity.

35089 **CARS measurements of temperature profiles near a wall in an internal combustion engine.** Lucht, R.P.; Maris, M.A. Warrendale, PA; Society of Automotive Engineers (1987). 7p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).
870459.

Broadband, coherent anti-Stokes Raman scattering (CARS) measurements of burned gas temperatures near a wall in an internal combustion engine have been performed. A lens-prism arrangement was used to traverse the probe volume perpendicular to the cylinder head wall while maintaining the alignment of the CARS optical system. The spatial resolution of the measurements was approximately 25-50 μm, and CARS signals were obtained at distances within 25 μm of the wall. Temperature profiles were measured 0.6, 2.7 and 4.2 msec after peak pressure was reached. A power law expression for the temperature profile in the boundary layer was optimized to achieve good agreement between measured and predicted profiles. The thickening of the boundary layer during the piston expansion stroke was clearly evident.

35090 **Formation of a plasma puff.** Cavolowsky, J.A.; Faris, D.W.; Oppenheim, A.K.; Smy, P.R. Warrendale, PA; Society of Automotive Engineers (1987). 11p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).
870609.

Formation of pulsed plasma jets, or puffs, was examined using several visualization techniques. Self-light streak photography was first employed to record salient global features of the development and structure of the jet. This provided information on the motion of the luminous gas particles in its core, revealing that plasma jets can have two distinct modes, being either totally subsonic or embodying a supersonic efflux manifested by the recorded streaks of Mach discs. At a fixed power pulse of electrical energy discharge in the plenum chamber, the outcome depends on the constriction imposed by an orifice at its outlet. Whereas the difference between the two types of jets was quite small, penetration in the subsonic case was found to be definitely larger than in supersonic. The turbulent evolution of the puffs was thereupon explored by ultra-high frequency (200 kHz) schlieren cinematography, using a unique system employing a pulsating ruby laser as the light source and a rotating mirror camera as the recorder.

35091 **The autoignition of isobutane in a knocking spark ignition engine.** Green, R.M.; Parker, C.D.; Pitz, W.J.; Westbrook, C.K. Warrendale, PA; Society of Automotive Engineers (1987). vp.p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).
870169.

The chemical aspects of the autoignition of isobutane are studied experimentally in a spark ignition engine and theoretically using computer simulations with a detailed chemical kinetic mechanism. The results of these studies show that even with the relatively knock-resistant fuel, isobutane, there is still a significant amount of fuel breakdown in the end gas with a resulting heat release and temperature increase. The ability of the detailed kinetic model to predict this low temperature chemical activity is assessed and the model is modified to simulate more closely the experimental observations. The authors address the basic question of whether this first stage of combustion accounts for a chemical preconditioning of the end gas that leads to the autoignition; or whether it merely provides sufficient heat release in the end gas that high temperature autoignition is initiated.

35092 **Visualization of flow and combustion processes in a square piston engine simulator.** Bonini, J.; Xia, L.Q.; Chau, E.; Hom, K. Warrendale, PA; Society of Automotive Engineers (1987). 9p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).
870452.

A square-piston engine simulator used at Berkeley to study both spark-ignited and diesel engine processes is described. The square piston configuration provides optical access to fluid mechanical and combustion processes through two flat quartz windows used as cylinder walls. Results from three previous research projects are reviewed to illustrate the engine's capabilities. Since these studies, we developed and used a color schlieren cinematography system to record in-cylinder processes. Color schlieren movies of both spark-ignition and diesel combustion reveal the essential fluid mechanical and combustion features within the engine. For these movies, the authors redesigned the diesel fuel system and installed a new liquid fuel injection system for spark-ignited operation. By preventing fuel and soot condensation on the windows, these new fuel systems improved the quality of our Schlieren images.

35093 **A study of velocities and turbulence intensities measured in firing and motored engines.** Hall, M.J.; Bracco, F.V. Warrendale, PA; Society of Automotive Engineers (1987). 28p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).
870453.

Laser Doppler velocimetry was used to make cycle-resolved velocity and turbulence measurements under motoring and firing conditions in a ported homogeneous charge S.I. engine. The engine

had a flat pancake chamber with a compression ratio of 7.5. In one study, the effect of the intake velocity on TDC turbulence intensity was measured at 600, 1200, and 1800 rpm with three different intake flow rates at each speed. The TDC swirl ratio ranged from 2 to 6. The TDC turbulence intensities were found to be relatively insensitive to the intake velocity, and tended to scale more strongly with engine speed. For the combustion measurements, the engine was operated at 600, 1200, and 2400 rpm on stoichiometric and lean propane-air mixtures. Velocity measurements were made in swirling and non-swirling flows at several spatial locations on the midplane of the clearance height.

35094 **Three dimensional numerical simulations of the UPS-292 stratified charge engine.** O'Rourke, P.J.; Amsden, A.A. Warrendale, PA; Society of Automotive Engineers (1987). 18p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

870597.

The authors present and analyze three-dimensional calculations of the spray, mixing and combustion in the UPS-292 stratified charge engine for three different operating conditions, corresponding to overall air-fuel ratios between 22.4 and 61.0. The numerical calculations are performed with KIVA, a multidimensional arbitrary-mesh, finite-difference hydrodynamics program for internal combustion engine applications. The calculations use a mesh of 10,000 computational cells. Each operating condition is calculated from intake valve closure at 118° BTDC to 90° ATDC and requires approximately three hours of CRAY-XMP computer time. Combustion occurs primarily in the wake of the spark plug, and to include the effects of the spark plug on the flow field, we use a novel internal obstacle treatment. The methodology, in which internal obstacles are represented by computational particles, promises to be applicable to the calculation of the flows around intake and exhaust valves.

35095 **Experimental and analytical study of heat radiation in a diesel engine.** Wahiduzzaman, S.; Morel, T.; Timar, J.; De Witt, D.P. Warrendale, PA; Society of Automotive Engineers (1987). 17p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

870571.

An experimental study was conducted of the heat radiation in a single-cylinder direct injection 14 iota engine. The engine was operated at speeds ranging from 1000 to 2100 RPM and a variety of loads. The radiation was measured using a specially designed fiber optics probe operating on the two-color principle. The probe was located in the head at two different locations: in one location it faced the piston bowl and in the other it faced the piston crown. The data obtained from the probe was processed to deduce the apparent radiation temperature and soot volume concentration as a function of crank angle. The resultant profiles of radiation temperature and of the soot volume concentrations were compared with the predictions of a zonal heat radiation model imbedded in a detailed two-zone thermodynamic cycle code.

35096 **Autoignition of methanol and ethanol sprays under diesel engine conditions.** Siebers, D.L.; Edwards, C.F. Warrendale, PA; Society of Automotive Engineers (1987). 13p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

870588.

Methanol and ethanol are being considered as alternative fuels for diesel engines. One of the key concerns with using alcohol fuels in diesel engines is their poor ignition quality. This work presents the ignition characteristics of methanol and ethanol examined under simulated diesel engine conditions in a constant-volume combustion vessel. The ignition characteristics of isooctane and normal hexadecane (cetane) measured under the same conditions are also included for reference. Results show that to obtain ignition delays and rates-of-pressure-rise suitable for current diesel engine designs, methanol and ethanol require in-cylinder temperatures of about 1100 K at the time of injection. The results also show that the ignition delays of the alcohol fuels are independent of the chamber-pressure and are unaffected by the presence of 10% by volume of water in the fuel.

35097 **The Advanced Turbine Technology Applications Program, ATTAP.** Kramer, S.B.; Kerwin, P.T.; Schettino, J.C. Warrendale, PA; Society of Automotive Engineers (1987). 6p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

870467.

An overview of the Advanced (Automotive) Gas Turbine Program, sponsored by the U.S. Department of Energy, is presented. The origins of the program and its driving forces are discussed. The central position of ceramic structural materials in the AGT program is pointed out as well as progress in the development of such materials up to the present time. To continue essential R&D in the area of ceramic materials and their application to the gas turbine engine a new program has been introduced. This is the Advanced Turbine Technology Applications Program (ATTAP). A plan for conducting ATTAP is offered in some detail.

35098 **An engine simulator for laser diagnostic studies of one-dimensional turbulent flame propagation.** Witze, P.O. (Sandia National Labs., Livermore, CA 94550). pp 305-314 of Proceedings of international symposium on diagnostics and modeling of combustion in reciprocating engines. Tokyo, Japan; The Japan Society of Mechanical Engineers (1985). (CONF-850915—).

From International symposium on diagnostics and modeling of combustion in reciprocating engines; Tokyo, Japan (4 Sep 1985).

An experimental facility for investigations of turbulent flame propagation velocities in piston engines is described. Two-component laser Doppler velocimetry is used to measure the expansion velocity and turbulence intensities in the preflame gas. A laser-schlieren flame position detector simultaneously records the flame location on a cycle-resolved basis. Conditional sampling procedures are used to reduce bias errors introduced by cyclic variations in the combustion rate. At the time of ignition the engine head and piston form an idealized combustion chamber designed to reduce cyclic variations in the fluid motion, while at the same time providing a high turbulence level characteristic of production engines. Combustion rates and velocity measurements are used to compare this chamber with an open disc chamber and with a research configuration having grid-like turbulence. The combustion rate in the idealized configuration is shown to be comparable to the rate in the open disc chamber, but with greatly reduced cyclic variation.

35099 **Preliminary study of flame structure in an internal combustion engine using 2-D flow visualization.** Zur Loye, A.O.; Bracco, F.V.; Santavicca, D.A. (Dept. of Mechanical and Aerospace Engineering, Princeton, NJ). pp 249-258 of Proceedings of international symposium on diagnostics and modeling of combustion in reciprocating engines. Tokyo, Japan; The Japan Society of Mechanical Engineers (1985). (CONF-850915—).

From International symposium on diagnostics and modeling of combustion in reciprocating engines; Tokyo, Japan (4 Sep 1985).

The structure of the turbulent flame in a premixed charge internal combustion engine was investigated at engine speeds of 300, 600, 1200, and 1800 rpm. A laser sheet, 200 microns thick and 1 cm wide, was passed through the turbulent flame front and the intensity of the light scattered by seeding particles was measured, thus obtaining two dimensional (2-D) cross-sections of the flame front. At the lower engine speeds the flame fronts were mostly continuous with some apparent pockets of unburned gas. As the engine speed was increased the flame fronts were more strongly distorted and the frequency of (what appeared to be) multiply connected flame sheets increased. The measured flame thicknesses varied from 300 microns to 1000 microns with the larger values more common at higher speeds. At least some of the variation was due to the flame being tilted with respect to the laser sheet but uncertainties persist as to the accuracy of the measured thicknesses.

35100 **New diagnostic techniques in engine combustion research.** Hartley, D.L.; Dyer, T.M. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). pp 27-38 of Proceedings of international symposium on diagnostics and modeling of combustion in reciprocating engines. Tokyo, Japan; The Japan Society of Mechanical Engineers (1985). (CONF-850915—).

From International symposium on diagnostics and modeling of combustion in reciprocating engines; Tokyo, Japan (4 Sep 1985).

The application of advanced diagnostics and computer analysis to the study of combustion processes in IC engines has been a major element of the Combustion Research Facility program for a decade. Working closely with industry and universities, a series of research objectives related to critical engine combustion problems has been defined, and these objectives have dictated an evolution of experimental and computational capabilities. A significant element in the experimental program is the optically-ported research engine designed for access by our diagnostics, and with sufficiently simplified geometrical design to be modeled by the computer analysts. Several of these engines are used with different diagnostic systems for studying the important combustion issues.

35101 **A turbulent burning law derived from combustion experiments.** Hoult, D.P.; Nguyen, V.H. (Dept. of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 315-324 of Proceedings of international symposium on diagnostics and modeling of combustion in reciprocating engines. Tokyo, Japan; The Japan Society of Mechanical Engineers (1985). (CONF-850915—).

From International symposium on diagnostics and modeling of combustion in reciprocating engines; Tokyo, Japan (4 Sep 1985).

Experimental and theoretical studies on the turbulent combustion process have been done on a constant volume combustion bomb. The flow into and out of the combustion bomb is computer controlled by specific valve opening and closing sequences. The nominal turbulent intensity in the bomb depends on the time delay after all valves are closed. Combustion experiments using a premixed propane-air mixture at equivalence ratios of 1.1, 1.0, and 0.95 have been performed in conjunction with spark delay times of 30 to 240 msec which correspond to a three fold variation in nominal turbulent intensity. The study focuses on the regime where the nominal initial turbulent intensity is about twice the laminar flame speed, which commonly arises in spark ignition engines. The behaviors of the mass burned fraction, front position, and turbulent burning speed, S/sub b/ are analyzed to extract general features of the underlying turbulent combustion process.

35102 **An application of laser diagnostics to the study of end-gas autoignition and engine knock.** Green, R.M.; Lucht, R.P. (Combustion Research Facility, Sandia National Labs., Livermore, CA 94550). pp 259-266 of Proceedings of international symposium on diagnostics and modeling of combustion in reciprocating engines. Tokyo, Japan; The Japan Society of Mechanical Engineers (1985). (CONF-850915—).

From International symposium on diagnostics and modeling of combustion in reciprocating engines; Tokyo, Japan (4 Sep 1985).

Stable and repeatable knocking operation has been achieved in a spark ignition, optical research engine. High swirl and multipoint ignition are used to confine the end gas in the center of the combustion chamber, while manifold temperature and pressure control the degree of the knock response. Knock appears to be the result of a nearly homogeneous and simultaneous autoignition of the end gas. Two laser diagnostic techniques, spontaneous Raman scattering and coherent anti-Stokes Raman spectroscopy (CARS), were used to measure the end-gas temperature history. These techniques are described and the results are compared. Higher end-gas temperatures under knocking conditions are shown to be due to higher wall temperatures.

35103 **Modeling and diagnostics of combustion in spark-ignition engines.** Bracco, F.V. (Dept. of Mechanical and Aerospace Engineering, Princeton Univ., Princeton, NJ 08544). pp 1-14 of Proceedings of international symposium on diagnostics and modeling of combustion in reciprocating engines. Tokyo, Japan; The Japan Society of Mechanical Engineers (1985). (CONF-850915—).

From International symposium on diagnostics and modeling of combustion in reciprocating engines; Tokyo, Japan (4 Sep 1985).

Subjects are considered that have not been extensively covered in recent reviews. The following is concluded. Simple ensemble averaging is not suited for engine flows. In an engine, what is turbulence and what is bulk (mean) flow is relative to the process that is influenced by the flow. Near TDC, turbulence is always insensitive to the details of the turbulence generated during intake. For a given engine, without strong squish and/or swirl, turbulence intensity and diffusivity near TDC increase with increasing initial turbulent diffusivity but run into upper limits imposed by turbulence damping due to the chamber walls. In spite of many uncertainties and limitations, multi-dimensional combustion models have been shown to be useful by industrial applications. Improved modeling of the flame structure is the subject of greatest current interest.

3302 External Combustion Engines

35104 **(DOE/NASA—0343-1) EHD analysis of and experiments on pumping leningrader seals.** Eusepi, M.W.; Walowit, J.A. (Mechanical Technology, Inc., Latham, NY (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Jun 1986. Contract AI01-85CE50112. 91p. (NASA-CR—179570; MTI—86TR33). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010642.

An analysis has been developed to predict the performance of pumping Leningrader reciprocating rod seals when the inlet (gas) side of the seal bore is formed by an expansion ring rather than by machining. The prediction of seal performance is based on the use of charts which provide necessary design parameters without the need for computerized calculations. A numerical example has been included to demonstrate the use of the design charts. Potential means for controlling and optimizing both performance and life capability is also provided. An experimental study was also conducted as part of the overall program in order to evaluate pumping Leningrader seals constructed in accordance with the analysis. Several seal materials, ranging in elastic modulus from 1.59×10^3 MPa for filled PTFE to 4.58×10^3 MPa for poly(amide-imide) were tested. For the limited number and durational tests conducted, the experiments showed that the ring expanded inlet type seal has the ability to provide desired levels of sealing. Additionally, it was shown that the lower modulus materials are more easily fabricated into seals and provide better sealing capability. 28 figs., 17 tabs.

35105 **Mod II engine performance.** Richey, A.E.; Huang, S.C. Warrendale, PA; Society of Automotive Engineers (1987). 6p. (CONF-870204—). Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096.

From Society of Automotive Engineers international congress and expo; Detroit, MI, USA (23 Feb 1987).

870101.

The Automotive Stirling Engine Program (ASE) is directed at the development of a kinematic Stirling engine for automotive use. This program is sponsored by the Department of Energy (DOE) and managed by the NASA-Lewis Research Center (NASA-LeRC). Following proof-of-concept testing and development of promising performance values with early versions of the Stirling engine, a production-type automotive design, the Mod II engine, was developed. The design of this engine and its systems has been previously presented. Based on this design, the first engine has been built and development testing has started. Projections for this first engine build are presented in this paper. Results of initial tests are also given including identification of development items and formulation of plans for resolution of existing deficiencies.

3306 Vehicle Design Factors

REFER ALSO TO CITATION(S) 34564

3307 Emission Control

REFER ALSO TO CITATION(S) 34488, 34489, 34490, 34543, 35083, 35085, 35657

35106 **(PB—87-161261/XAB) Characterization and analysis of polycyclic aromatic hydrocarbons.** Breuer, G.M.; Smith, J.P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 1984. 47p. NTIS, PC A03/MF A01.

Sampling and analytical procedures were developed for determining the concentrations of polycyclic aromatic hydrocarbons in animal-exposure chambers during studies on exposure to diesel exhaust, coal dust, or mixtures of these two pollutants. Fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(e)pyrene, benzo(k)fluoranthene, and benzo(a)pyrene were used as representative polycyclic aromatic hydrocarbons. High-pressure liquid chromatography with fluorescence detection was used for analysis. Coal-dust only samples revealed a broad, rising background in the chromatogram with small peaks superimposed corresponding to fluoranthene, pyrene, and benzo(a)anthracene, diesel exhaust only samples showed many peaks on a flat baseline including those corresponding to fluoranthene, pyrene, benzo(a)anthracene, benzo(k)fluoranthene, and benzo(a)pyrene. In general, no polynuclear aromatics were noted in the clean air samples. The authors note that relatively minor changes in air/fuel ratio, lubricant, fuel, and load may have substantial effects on very minor components of the exhaust emission.

35107 **(PB—87-163507/XAB) Particulate diesel-exhaust characterization study.** Glaser, R.; Cooper, C.; Deye, G.; Ong, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1983. 61p. NTIS, PC A04/MF A01.

See also PB—87-163499.

Several analyses were made of the diesel-exhaust particulates which were used in a study made to determine the effects of long-term exposure to coal dust and exhaust from diesel engines on laboratory animals. The diesel engine used was of a type used in underground-mining operations, and was equipped with a water scrubber in the exhaust line. Lipid chromatographic fluorescence detection of the solvent extracts of the diesel exhaust components showed fluorescing compounds covering a wide range of polarity to be present in the exhaust samples. Preparative fractions of solvent extracts of particulate diesel exhaust indicated that the majority of the mass recovered was in the nonpolar fraction. Sufficient quantities of nitroarenes were isolated for identification purposes; high-resolution mass spectroscopy with selected ion monitoring was used. 1-Nitropyrene and a nitrofluorene isomer were identified in several of the extract fractions. Both direct and enzyme-activated mutagens were present in the diesel particulate and scrubber water extract and the unextracted scrubber particulate. The authors conclude that the contents of the scrubber may represent a significant health hazard due to the presence of mutagens.

35108 **(PB—87-163515/XAB) Measurement of n-nitrosamine concentrations in NIOSH (National Institute for Occupational Safety and Health) Diesel Exhaust/Coal Dust Study.** Choudhary, G.; Foley, G.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Physical Sciences and Engineering). 1983. 29p. NTIS, PC A03/MF A01.

See also PB—87-163507.

Measurements were taken of N-nitrosamine concentrations present in the animal chambers used during the NIOSH Diesel Exhaust/Coal Dust study. Monthly, and sometimes weekly, samples were taken. Samples were taken over 2 to 7 hours. The following nitrosamines were sought: N-nitrosodimethylamine (NDMA), N-nitrosodiethylamine (NDEA), N-nitrosodipropylamine (NDPA), N-nitrosodibutylamine (NDBA), N-nitrosopiperidine (NPIP), N-nitrosopyrrolidine (NPYR), N-nitrosomorpholine (NMOR), and N-nitrosodiphenylamine (NDPhA). Only NDMA, NDEA, and NDPA were detected above the detection limits of the system, 6.0 nanograms/cubic meter. Precursors of nitrosamine formation were present in and prior to the exposure chambers, as indicated by the conversion of nitrosatable amines in samplers into the corresponding nitrosamine. The authors conclude that the observed nitrosamines appear to occur subsequent to diesel-exhaust emission from the engine.

35109 **(PB—87-163945/XAB) Effects of methanol fuel substitution on multi-day air-pollution episodes. Final report, 9 June 1984-8 April 1986.** Carter, W.P.L.; Atkinson, R.; Long, W.D.; Parker, L.N.; Dodd, M.C. (California Univ., Riverside (USA). Statewide Air Pollution Research Center). Sep 1986. 287p. NTIS, PC A13/MF A01.

A series of indoor and outdoor environmental-chamber experiments were conducted to investigate the effects on ambient air quality of widespread conversion of motor vehicles to methanol fuel. Three organic surrogates were compared in 2- to -3-day NOx-air irradiations: a base-case mixture representing present emissions into the California South Coast Air Basin; a mixture in which 33% (by carbon) of the base mix was substituted by methanol; and a mixture in which 33% of the base mix was substituted by a 90% methanol, 108 formaldehyde mix. The organic/NOx ratio was varied from 3 to 15. Substitution by methanol alone resulted in reduced day 1 ozone and PAN formation in all experiments, with the ozone benefit being less on day 2.

35110 **(PB—87-164372/XAB) Photochemical modeling of methanol-use scenarios in philadelphia. Final report.** Whitten, G.Z.; Yonkow, N.; Myers, T.C. (Systems Applications, Inc., San Rafael, CA (USA)). Mar 1986. 136p. NTIS, PC A07/MF A01.

A photochemical modeling study was conducted to estimate the impact on smog production resulting from the substitution of methanol fuel for gasoline and diesel fuel in Philadelphia in the year 2000. Three photochemical models were used: a comprehensive grid model adapted from the Urban Airshed Model (UAM), a four-cell trajectory model (a Lagrangian version of the UAM), and a single-cell box model. Emission rates, initial conditions, and boundary values were forecast to the year 2000. Model sensitivity tests indicate that methanol substitution above 20 percent of the overall Volatile Organic Compound inventory may significantly inhibit smog formation, but the reduction also depends strongly on other factors such as formaldehyde emissions, methanol carryover from upwind sources or previous days, and NOx levels. Whereas formaldehyde emissions tend to accelerate ozone formation, methanol carryover and NOx emissions tend to decrease ozone formation.

35111 **(PB—87-169439/XAB) Investigation of the variation of in-service vehicle emissions and fuel economy with age and mileage accumulation: Stage 1.** Potter, C.J.; Savage, C.A. (Warren Spring Lab., Stevenage (UK)). 1985. 61p. (LR—562(AP)-M). NTIS, PC PC E06/MF E06.

The emissions of carbon monoxide, total hydrocarbons and nitrogen oxides and fuel economies of two groups of four cars were measured from the pre-delivery inspection stage. It was found that the settings of the variable jet carburetors of the first group were inherently unstable, which resulted in CO emissions before each major service that were up to 379% of the ECE R15-03 conformity of production limit. The hydrocarbons emissions were up to 200% of the limit. Nitrogen oxides emissions were very low. After service it was possible to restore the emissions to acceptable limits and reduced fuel consumptions. The second group of cars were also fitted with variable jet carburetors and have only accumulated 7000-24,000 miles. The results to date indicate that these cars have relatively stable emissions and fuel economies.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 35082, 35085, 35087, 35091, 35096, 35101

35112 (NZERDC—128) Compressed biogas at the Christchurch Drainage Board: Final report. (Worley Consultants Ltd., Christchurch (New Zealand); New Zealand Energy Research and Development Committee, Auckland). Apr 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87900756.

This report describes the experience of the Christchurch Drainage Board in using biogas for fuelling a part of its transport fleet. The object of the report is to document this experience and demonstrate the benefits to other potential users of biogas. The Drainage Board has designed and built a compressed biogas (CBG) refuelling station at its Christchurch sewage treatment works. The features of this station and the experience of the first 21 months of operation are described. The station is now operating at its maximum design capacity of approximately 800 cubic metres per day and few major problems have been experienced. A range of petrol-driven vehicles from 5000 cc trucks to 800 cc vans has been converted to CBG/petrol dual fuel operation using standard compressed natural gas conversion equipment. No major problems have been encountered with this conversion work. Details of fuel consumption, range and extent of petrol substitution are given for the 30 vehicles which had completed a minimum of 12 months operation on CBG by September 1984. These results indicate that for practical purposes, one cubic metre of scrubbed gas can be considered equivalent to one litre of petrol. Vehicle maintenance costs are discussed and it is concluded that in the Christchurch Drainage Board's experience, maintenance costs for CBG vehicles are slightly greater than for the equivalent petrol vehicle. It is concluded that the net annual saving in petrol costs is $56,000 in 1983 terms and that this saving is likely to increase as the price of petrol increases in real terms.

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 35307, 35552

35113 (AD-A—178138/4/XAB) BEAST: a high-performance Battle Engagement Area Simulator/Tracker. Memorandum report. Boris, J.P.; Picone, J.M.; Lambrakos, S.G. (Naval Research Lab., Washington, DC (USA)). 31 Dec 1986. 58p. (NRL-MR—5908). NTIS, PC A04/MF A01.

The Surveillance, Correlation, and Tracking (SCAT) problem is the computation-limited kernel of future battle-management systems currently being developed, for example, under the Strategic Defense Initiative (SDI). This report shows how high-performance SCAT can be performed in this decade. Estimates suggest that an increase by a factor of at least one thousand in computational capacity will be necessary to track 10^5 SDI objects in real time. This large improvement is needed because standard algorithms for data organization in important segments of the SCAT problem scale as N^2 and N^3, where N is the number of perceived objects. It is shown that the required speed-up factor can now be achieved because of two new developments: 1) a heterogeneous element supercomputer system based on available parallel-processing technology can account for over one order of magnitude performance improvement today over existing supercomputers; and 2) algorithmic innovations development recently by the NRL Laboratory for Computational Physics will account for another two orders of magnitude improvement. Based on these advances, a comprehensive, high-performance kernel for a simulator/system to perform the SCAT portion of SDI battle management is described.

35114 (AD-A—178242/4/XAB) Biological warfare; a selected bibliography. Shope, V. (Army War Coll., Carlisle Barracks, PA (USA)). Feb 1987. 13p. NTIS, PC A02/MF A01.

Biological warfare, perhaps the most condemned method of waging war, involves the use of disease-producing micro-organisms intended to cause illness or death in humans. Today biological warfare agents and their delivery systems have reached new levels of sophistication. With that in mind, over 100 nations were party to the Biological Weapons Convention, ratified by the United States in 1975, which prohibits (except for peaceful purposes) the development, production stockpiling, transfer, or acquisition of biological agents and their means of delivery. However, it can be expected that the major military powers of the world will continue their efforts to be prepared to defend themselves against germ warfare. This bibliography provides a valuable list of articles, books and documents which form a solid and wide ranging view of contemporary material written about this emotionally charged topic. Some of the cited materials also cover nuclear and chemical warfare.

35115 (AD-A—178649/0/XAB) Threat and opportunity: the Soviet view of the Strategic Defense Initiative. Master's thesis. Uchrinscko, K.W. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1986. 140p. NTIS, PC A07/MF A01.

The Soviet response to the Strategic Defense Initiative (SDI) during the period March 1983 through November 1985 provided indications of their view of the program both as a threat and as an opportunity to weaken NATO. The SDI is seen not only as a threat to the physical security of the Soviet Union but as part of an effort by the United States to seize the strategic initiative by neutralizing the military component of Soviet strategy. A major objective of that strategy is the political separation of Western Europe from the United States, which the Soviets sought to facilitate by aggravating allied concern over the SDI's potential implications for European security and economic interests.

35116 (PB—87-170759/XAB) Ground contamination in woodland. Experiments with a training chemical warfare agent). Karlsson, E.; Burstroem, B.; Faengmark, I.; Lindberg, G.; Nordstrand, M. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jan 1987. 20p. (In Swedish). (FOA-C—40236-4.5). NTIS, PC PC E03/MF E01.

The ground contamination in different types of woods was determined at an experiment with a training chemical warfare agent. As expected, the ground contamination was not as homogeneous as it was in an open area. Still the maximum values in the wood and in the open area are about the same. The average ground covering in thick mixed wood was 35% of the value in open area. In a thin pinewood the corresponding figure was 63%. In spite of the lower average value in wood it may be difficult to avoid personal contamination as you often have to stay in the glades where the ground contamination is large.

3501 Policy, Negotiations, And Legislation

35117 (AD-A—177908/1/XAB) Interim Strategic Defense Initiative arms negotiation strategy. Research report. Marshall, H.A. (Air War Coll., Maxwell AFB, AL (USA)). May 1986. 34p. (AU-AWC—86-138). NTIS, PC A03/MF A01.

Comments are presented on some of the pros and cons of the Strategic Defense Initative (SDI). Key issues discussed relate to the projected cost of SDI and the potential violation of the 1972 Antiballistic Missile Treaty. A solution is proposed that has the potential to significantly reduce the total cost and circumvents the treaty resulting in the deployment of a more-effective ballistic missile defense system.

3503 Verification

REFER ALSO TO CITATION(S) 34994, 35554

36 MATERIALS

REFER ALSO TO CITATION(S) 35953, 36095

35118 (LBL—23333) On mechanical behavior of metal-ceramic bonded systems. Lu, Mei-Chien. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010818.

A study of the mechanical behavior of metal/ceramic bonded systems is achieved by using a simple model system consisting of two ceramic bodies and a metal interlayer. The mismatch of the material properties across the interface strongly affects the stress fields in the system and thus the mechanical strength. Four important factors determine the mechanical strength of a bonded material; the yield strength of the metal, mismatch of material properties, the dimensionless thickness of the metal, d/h, and the defects at the interface. The finite element method, in conjunction with the virtual extension technique, is used to evaluate the stress fields as well as the strain energy release rate and predict the possible failure strength. Edge-dominated failure is found to be important when the yield strength of metal is large, whereas limit load failure may exist in the metal when the yield strength is small. Reduction of the thickness of the metal diminishes edge stress concentrations and increases the limit load. Residual stresses and the crack blunting induced by metal plasticity also affect the failure. The failure strength of diffusion bonded Al_2O_3/Au is evaluated by a bending test and the corresponding microstructure at the interface examined by scanning electron microscopy. The effect of the defects at the interface is then related to the stress fields, through the use of failure statistics. A map including the general failure mechanisms is presented to summarize the mechanical behavior of the bonded systems.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 34618, 34665, 34666, 34683, 34821, 34821, 34823, 34823, 34839, 34841, 34842, 34861, 35066, 35326, 35346, 35410, 35485, 36156, 36168, 36173

35119 **(AD-A—178084/0/XAB) Navy product-improvement program for Turbomach T-62t APU's corrosion-resistant turbine wheel/improved bearing and lubrication system. Final report, 19 January 1983-12 April 1986.** Robertson, W.A. (Sundstrand Turbomach, San Diego, CA (USA)). 12 May 1986. 76p. (ERR—0632). NTIS, PC A05/MF A01.

Titan T-27 and T-40-1 gas turbine engines have used IN-713 LC turbine wheels for many years without serious hot-corrosion problems. For extended operation in marine environments, however, the well-known susceptibility of Alloy 713 to hot corrosion (sulfidation) could lead to deterioration of airfoil surfaces resulting eventually in loss of engine performance, or even engine failure. Corrosion protection could be enhanced by protective coatings; however, with base material so poor in hot-corrosion resistance as Alloy 713, the reliability of a 713 turbine wheel would be suspect. Also, degradation of mechanical properties accompanying the coating process would reduce the safety margin below acceptable, and appears to justifya material change to an alloy with better hot-corrosion resistance. The alloy selected was MAR-M247, a nickel-based alloy with 10% cobalt, 10% tungsten, 8,25% chromium, 5.5% aluminum, 3% tantalum, 1.5% hafnium, 1% titanium, and other elements. The expected improvements over IN-713 LC include improved oxidation/hot corrosion resistance, blade creep resistance, and tensile strength.

35120 **(AD-A—178337/2/XAB) Oxidation resistance of CVD (chemical vapor deposition) coatings. Final report, September 1984-August 1986.** Harding, J.T.; Fry, V.; Tuffias, R.H.; Kaplan, R.B. (Ultramet, Pacoima, CA (USA)). Feb 1987. 29p. NTIS, PC A03/MF A01.

Chemical vapor deposition (CVD) of iridium, platinum, rhodium, zirconia oxide, and hafnia oxide was investigated for the purpose of protecting Re, molybdenum, Ni, Nb, copper, and carbon composites from oxidation at temperatures from 1000 to 2000 C. Iridium has proved easiest to deposit. Earlier difficulties with codeposition of carbonaceous residues were overcome, and dense, adherent, coatings that stop oxidation of the substrate were reliably produced. The iridium deposition process developed here was applied in the fabrication of several rhenium thrusters. Some of these were test fired by Aerojet Techsystems using MMH/NTO propellant. One chamber has completed over 8 hours of operation including over 3600 starts and 4 hours burn time between 2150 and 2200 C at a mixture ratio of 1.65. No measurable change in throat diameter was observed, and the mass loss was only 0.9 g or 1.4%.

35121 **(AD-A—178596/3/XAB) Corrosion, wear and mechanical properties of pulse-electrodeposited alloys. Final report, September 1983-November 1986.** Weil, R.; Kim, W. (Stevens Inst. of Tech., Hoboken, NJ (USA)). 1 Mar 1987. 36p. NTIS, PC A03/MF A01.

The objective of this investigation was the use of pulse plating to improve the properties of electrodeposits and to develop new materials. It was necessary to design and build a minitensile device capable of measuring elastic and plastic properties of thin foils over a large range of strain rates and which used a specimen with the width and gage length scaled to the thickness. A cell for determining hydrogen permeation through electrodeposits was also built. The previously reported reduction of the internal stress in nickel-molybdenum deposits was investigated further as was that in nickel. An observed compressive stress which developed each time that the current was turned on and then changed to tensile was explained in terms of hydrogen expanding the surface layer. Hydrogen was also thought to be responsible for a decreasing stress with increasing pulse frequency when nickel was plated on palladium substrates. The reduction of Mo by hydrogen also during the time the pulsed current was off was the probable cause of a higher alloy content of Ni-Mo deposits and lower stress. The mechanical properties of Ni-Mo deposits were determined. The reason for the high ductility exhibited by composites consisting of alternate layers of ordered and disordered beta brass obtained by pulse plating was found to be due to a strain-induced martensitic transformation. Apparently, martensite strengthened the region where necking started and inhibited its leading to fracture. Grain-size refinement resulting from the periodic imposition of anodic pulses lead to a three-fold strength increase in nickel deposits as well as a decrease in their coefficients of friction.

35122 **(AD-A—178802/5/XAB) Liquid-phase sintering of tungsten heavy alloys in vacuum.** Bose, A.; Rabin, B.H.; German, R.M. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Materials Engineering). 1986. 14p. NTIS, PC A02/MF A01.

Pub. in Progress in Powder Metallurgy, Vol. 42, 557-567(1986).

Recent research on tungsten heavy alloys have shown that mechanical-property improvement might be obtained by sintering in vacuum. Samples were held at 800 C for one hour and then heated to 1300 C in hydrogen. A vacuum of 0.7 mPa (about 5 microtorr) was then applied before the liquid phase was formed. After sintering at 1480 C for 30 minutes, the furnace was backfilled with argon and then allowed to cool. Theoretical densities were achieved by this process; however, matrix-phase vaporization occurred during prolonged sintering. The vacuum-sintering treatment was applied to a series of heavy alloys containing 88 to 97 wt% tungsten. The tensile properties of the alloys were superior to those of similar alloys sintered in dry hydrogen and were comparable to the maximum values reported in the literature.

35123 **(BNL—39687) Influence of pH on the localized corrosion of iron.** Webley, R.; Henry, R. (Massachusetts Inst. of Tech., Brookhaven, NY (USA). School of Chemical Engineering Practice-Brookhaven Station). Jun 1986. Contract AC02-76CH00016. 66p. (MIT/BNL—86-6). NTIS, PC A04/MF A01; GPO Dep. File Number DE87010452.

The influence of pH on the pitting corrosion of iron in chloride and sulfate solutions was determined using two artificial pit apparatuses to obtain the pH near the surface of the pit bottom. A glass membrane electrode and an antimony electrode were used to measure pH in the two apparatuses. Using solutions of NaCl and Na_2SO_4 at current densities of 0.5, 5.0, and 10 mA/cm^2 pH's in the range 5 to 6 were obtained with the first apparatus. The antimony probe did not measure pH accurately in solutions of 1 N NaCl and 1 N Na_2SO_4 and had an error of approximately 2 pH units. A one-dimensional transport model was developed to predict pH variations around the pit mouth and inside the pit. The validity of this model was not verified due to the relative lack of precision with pH measurement techniques.

35124 (CONF-870862—2) A TEM study of amorphization in NiTi irradiated with Ni^{2+} ions at room temperature. Maziasz, P.J.; Packan, N.H.; Pedraza, D.F.; Lee, E.H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008776.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

Irradiation of a crystalline solid solution can cause the decomposition of the matrix into enhanced, modified thermal, or irradiation-induced precipitate phases. Irradiation can also transform the matrix into a new crystalline phase. Alternatively, the heavily irradiated matrix can become amorphous. Alloys of NiTi are intermetallic compounds with shape-memory applications whose amorphization is of both technological and basic scientific interest. Purpose of this paper is to observe some details of the intermediate stages of amorphization to provide further insight into the mechanisms of the phenomenon.

35125 (CONF-8703118—2) A neutron scattering study of the kinetics of phase separation in Mn/sub 1-x/Cu/sub x/. Gaulin, B.D.; Spooner, S.; Morii, Y. (Oak Ridge National Lab., TN (USA); Japan Atomic Energy Research Inst., Tokai, Ibaraki. Physics Div.). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008587.

From NATO advanced study institute conference on time dependent effects in disordered materials; Geilo, Norway (29 Mar 1987).

We have undertaken a time resolved small-angle neutron scattering study of Mn/sub 1-x/Cu/sub x/ for $x = 0.4$, 0.33, and 0.2 to examine the kinetics of phase separation. Both early and late time behavior were investigated for $x = 0.33$ so as to establish a comprehensive kinetic description of the process.

35126 (DOE/ER/45055—21) A summary of recent research on mechanical behavior of polycrystalline solids for period 4/86-6/87. Li, Che-Yu. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). Apr 1987. Contract FG02-84ER45055. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011072.

During the period April 1986 to June 1987 the work was performed in the following areas: (1) Strain aging; (2) Grain boundary sliding; and (3) Ordered intermetallic alloys.

35127 (DOE/ER/45155—3) Moderate and low temperature oxidation of clean nickel, chromium, and Ni-Cr alloys: Progress report, August 1, 1986-July 31, 1987. Holloway, P.H.; Batich, C.D. (Florida Univ., Gainesville (USA)). Apr 1987. Contract FG05-84ER45155. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011089.

Metals are inherently thermodynamically unstable and will react with atmospheric gases or water to produce oxide, hydrated oxides, etc. Normally this product will degrade the mechanical, physical, etc., properties of the metallic part. Fortunately the oxides produced by the reactions usually reduce the rate of subsequent reaction making it feasible to build structures with metals. It has been found for stainless steels and nichrome alloys that the addition of chromium (Cr) significantly improves the ability of the oxides to passivate (reduce the reaction rate of) the metallic surface. However because Cr is a strategic material whose supply is controlled by countries other than the US, it is important to develop a scientific basis for substituting other elements for Cr in metallic alloys. This paper reports on the fundamental study of the development of passivating oxide films on Ni-Cr alloys.

35128 (DOE/ER/45213—5) Microchemical analysis of polycrystalline Ni_3Al and other ordered alloys using the field-ion microscope atom probe: Progress report. Brenner, S.S. (Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering). 15 Jan 1987. Contract FG02-85ER45213. 16p. (CONF-861207—107). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008833.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Field-ion microscopy and atom probe microanalysis have been used to determine the structure and chemistry of grain boundaries in ductile, recrystallized Ni_3Al containing 0.23 at. % B (500 wt ppM). Results indicate that the boron concentration fluctuates along the boundary plane and that the boron enriched zone is wider than expected from equilibrium-type adsorption. It was also found that boron lowers the aluminum concentration of some of the boundary regions.

35129 (DOE/ER/45257—1) A study of mechanisms of time-dependent crack growth at elevated temperature: Progress report, July 1986 to June 1987. Saxena, A.; Stock, S.R.; Gieseke, B.; Staley, J.T. (Georgia Inst. of Tech., Atlanta (USA). Fracture and Fatigue Research Lab.). 28 Feb 1987. Contract FG05-86ER45257. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010952.

Objective of this study is to conduct creep and creep-fatigue crack growth tests on Cu-Sb and to characterize the crack tip damage mechanisms in a model material which is known to cavitate at the grain boundaries under creep deformation. The data will be used to develop mechanistic models for cumulative crack tip damage under complex loading conditions at elevated temperature. The application of these models will also be extended to situations involving nonperiodic loading. The results of this program will be integrated into an EPRI study for characterizing the creep-fatigue crack growth behavior of Cr-Mo-V steels. Techniques to be used include electron metallography, x-ray and electron radiography and small angle neutron scattering (SANS).

35130 (DOE/ER/45260—1) The role of grain boundaries on the strength, ductility and toughness of $L1_2$ intermetallic compounds: Progress report on year 1, [July 15, 1986-March 15, 1987]. Schulson, E.M. (Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering). 16 Mar 1987. Contract FG02-86ER45260. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010821.

Objective of this program is to understand the mechanisms underlying the effects of grain boundaries on the flow and fracture of Ni_3Al and Ni_3Si. This report summarizes progress during year-1; i.e., from July 15, 1986-March 15, 1987.

35131 (DOE/ID/12380—13) Investigation of materials for inert electrodes in aluminum electrodeposition cells: Topical report, December 6, 1982-December 5, 1985. Haggerty, J.S.; Sadoway, D.R. (Massachusetts Inst. of Tech., Cambridge (USA); USDOE Idaho Operations Office, Idaho Falls). Jun 1987. Contract FG07-83ID12380. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010982.

The research program was designed to investigate candidate materials under conditions where material properties, performance, and failure modes can be interpreted with a level of confidence that is not possible with the poorly defined polycrystalline materials used in previous research. Two classes of candidate materials have been investigated. One is single-crystal materials grown in the uniquely controlled conditions achievable with the MIT laser-heated floating-zone crystal growth apparatus. The second comprises high purity powder synthesized from laser-heated gases. Produced samples were characterized in terms of fundamental material properties as well as those technological parameters which reflect exposures typical of the Hall cell. Objective is to define material compositions, critical fabrication process steps, and critical operating conditions which must be known before economically viable inert anodes and cathodes that exhibit adequate performance characteristics can be made.

35132 (GKSS—85/E/32) Defect microstructure and irradiation strengthening in Fe/Cu alloys and Cu bearing pressure vessel steels. Wagner, R.; Frisius, F.; Kampmann, R.; Beaven, P.A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1985. 13p. NTIS, PC E07; Available from NTIS as TIB/A86-10210.

The nature of the radiation damage and its dependence on Cu concentration have been studied in a series of Fe-Cu alloys and Cu containing pressure vessel steels, irradiated to $7 \cdot 10^{19}$ n/cm^2 ($E>0.1$ MeV) at 290°C, using a combination of TEM, SANS, and compression testing. The magnitude of the irradiation hardening in

the Fe-Cu-alloys is found to increase with the concentration of Cu in solution prior to irradiation, and is shown to be due to the formation of (I) Cu precipitates, and (II) a finer dislocation loop distribution than in Cu-free Fe. Preliminary SANS measurements on a series of pressure vessel steels show that the defect microstructures formed during irradiation are more complex than in Fe-Cu alloys.

35133 **(GKSS—86/E/20) Correlation between the microscopic distribution of radiation-induced free volume and the ductility of amorphous alloys.** Gerling, R.; Schimansky, F.P.; Wagner, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 6p. (CONF-8507116—2). NTIS, PC E07; Available from NTIS as TIB/A86-11064.

From 3. international conference on the structure of non-crystalline materials; Grenoble, France (8 Jul 1985).

Neutron-irradiation of thermally embrittled $Fe_{40}Ni_{40}P_{20}$ and $Fe_{40}Ni_{40}B_{20}$ amorphous alloys leads to a macroscopic swelling which effects a complete recovery of the ductility. Both the irradiation-induced swelling and the associated improvement of the ductility have been studied as a function of two types of damaging projectiles: fast neutrons, and α- and Li-particles generated by thermal neutrons. The total amount of swelling is independent of the type of damaging species and only depends on the damage level. However, the damage level required for complete restoration of the ductility depends strongly on the type of damaging projectiles. This is a consequence of large differences in the distribution of irradiation-induced free volume with respect to the two different damaging modes.

35134 **(GKSS—86/E/31) Some aspects of the crack tip opening displacement concept.** Schwalbe, K.H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1986. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-00424.

The crack tip opening displacement (CTOD) is shown to be an excellent correlation parameter for stable crack growth. A methodology based on the CTOD concept is developed which includes the experimental determination of the R-curve and an analytical model for the driving force. Minimum size requirements for a specimen to determine a valid R-curve are established. The prediction of failure conditions is in close coincidence with experimental results. Within the scope of the present paper the method is restricted to centre cracked tension geometries in plane stress conditions.

35135 **(HEDL—7596) 20,000-hour stress-corrosion cracking tests on ASTM A36 and A387-9 steels in simulated Hanford groundwater.** James, L.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Mar 1986. Contract AC06-76FF02170. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009518.

Modified WOL specimens were employed to evaluate the susceptibility of two candidate container materials, A36 and A387-9 steels, to SCC in simulated groundwater at 250°C. The test duration was 20,000 hours. Post-test measurements of specimen compliance were not possible because significant build-up of corrosion products and/or mineral deposits on the fracture faces prevented a linear relationship between load and displacement. Considerable load was "lost" due to time-independent plasticity, time-dependent deformation and crack-face wedging, but the amounts lost were comparable to similar short-term tests conducted earlier. A number of direct and indirect observations suggested that no crack extension occurred during the environmental exposure. One indirect observation, the initial pre-test compliance measurements, suggested a possibility of crack extension occurred, but it is believed that these measurements were in error because of the experimental test set-up used in the program.

35136 **(HEDL—7603) Fatigue-crack propagation behavior of ASTM A27 cast steel in simulated Hanford groundwater.** James, L.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Sep 1986. Contract AC06-76FF02170. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009519.

Fatigue-crack propagation (FCP) tests were conducted on specimens of cast ASTM A27 steel in simulated Hanford groundwater at 150°C and 250C°C. Fatigue loadings were employed as the most feasible means of accelerating the environmentally assisted cracking (EAC) process. A tentative threshold for EAC was established, and an example calculation was used to show how such a threshold can be related to allowable stress levels and flaw sizes to assure that EAC will not occur.

35137 **(HEDL-SA—3297-FP) The effect of fast-neutron irradiation on the fatigue-crack growth behavior of several austenitic stainless steels and weldments.** James, L.A. (Hanford Engineering Development Lab., Richland, WA (USA)). 8 Aug 1985. Contract AC06-76FF02170. 10p. (CONF-860722—27). Nuclear Technology, American Nuclear Society, 555 N. Kensington Ave., La Grange Park, IL 60525. File Number TI87008384.

From ASME pressure vessel and piping conference and exhibit; Chicago, IL, USA (20 Jul 1986).

Fatigue-crack growth specimens from a number of austenitic stainless steels and weldments [annealed Types 304 and 316, 20% cold-worked Type 316, SA-351 Grade CF8, Type 304/308 shielded-metal-arc (SMA) weldments, and Type 316/IN-82/IN-718 gas-tungsten-arc weldments] were irradiated in Experimental Breeder Reactor-II. Postirradiation crack-growth testing showed little or no effect of irradiation on the crack growth behavior of annealed Type 304, cold-worked Type 316, and Type 304/308 SMA weldments. On the other hand, irradiation produced a minor reduction in crack growth rates in annealed Type 316 and minor increases in crack growth rates in SA-351 Grade CF8 castings and Type 316/IN-82/IN-718 GTA weldments over certain ranges of ΔK. 11 fig.

35138 **(IS-T—1231) Microstructural characterization of ferromagnetic materials using magnetic NDE techniques.** Ranjan, R. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010918.

Magnetic NDE techniques, namely, the acoustic Barkhausen noise, the magnetic Barkhausen noise and the magnetic hysteresis curves, were simultaneously used for microstructural characterization of nickel and steels. Results showed that, in nickel, the non-180° domain walls interact more strongly with dislocations than the 180° domain walls. A study of the grain size effect on the magnetic and acoustic Barkhausen noises showed a great potential as a NDE grain size measurement tool. Moreover, the Barkhausen signals indicate that the 180° domain walls in nickel seem to have a stronger interaction with grain boundaries than the non-180° domain walls, as indicated by the acoustic Barkhausen signal. A theoretical model is being proposed to explain the grain size effect on the Barkhausen signals. The model takes into account the density of magnetic domain walls and their initial velocity, with both quantities being strongly dependent on microstructure. The acoustic and magnetic Barkhausen noises were also found to be very sensitive to the change in carbide morphology. It is proposed that the magnetic Barkhausen peak signal is caused by mainly domain nucleation and the acoustic Barkhausen peak signal due to domain growth.

35139 **(IS-T—1238) The optical properties of iron and dilute iron-aluminum alloys.** Sexton, J.H. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010925.

An interpolation scheme for the band structure of paramagnetic iron was used to model the band structure of ferromagnetic iron. This was carried out by superimposing two paramagnetic iron band structures with a 2.2 eV energy offset to simulate the exchange splitting. This model was used to calculate the optical conductivity of ferromagnetic iron. Good agreement was achieved with that calculated by Callaway and Wang. The broad peak in the iron optical conductivity (σ_1) at 2.5 eV is found to be due to transitions from minority-spin bands 2 and 3 to minority-spin bands 4 and 5 at locations throughout the interior of the Brillouin zone, but generally not on or near symmetry lines and points. The broad 6.0 eV peak in σ_1 is found to be due to the two two-dimensional band gap minimums near the middle of the Δ and Λ symmetry lines. These transitions occur in both the minority- and majority-spin band structures. Composition modulation spectroscopy was applied to iron using aluminum as a dilutant. Two characteristic features were present in the resulting $\Delta\epsilon_2$ spectra. These were a broad negative

peak at 2.5 eV and a broad positive peak at 6 eV - the same locations as the peaks in σ_1. The decrease in ϵ_2 at 2.5 eV is attributed to a depletion of electronic states in the host d bands. This depletion is mainly due to the valence difference between iron and aluminum. The increase in ϵ_2 at 6 eV is claimed to be due to band narrowing and/or the presence of a virtual bound state residing below the iron d bands.

35140 (IS-T—1243) Effects of oxygen and hydrogen on tensile and internal friction properties of niobium-vanadium alloys. Indrawirawan, H. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010933.

The effect of additions of up to 10 at. % vanadium on the oxygen Snoek peak in niobium was investigated by an internal friction technique. Vanadium-oxygen interaction peaks were identified at 500 and 650°K. For the Nb-0.24 at. % V and the Nb-0.42 at. % V alloys, at an oxygen/vanadium ratio greater than one, the 400°K unperturbed oxygen Snoek peak in niobium appears, thus providing strong evidence for oxygen trapping in these alloys. The 500°K peak is interpreted as a stress induced reorientation of oxygen associated with a single vanadium atom in a type n = 1 cell, whereas the 650°K peak is due to oxygen associated with two or more vanadium atoms in type n = 2 and n = 3 cells. The observed results are discussed in terms of the elastic and chemical interaction models for substitutional-interstitial solute interactions in a bcc lattice. Internal friction results do not provide evidence of an oxygen-hydrogen interaction. Hydrogen has no observable effect on the oxygen Snoek peak in unalloyed niobium and oxygen has no effect on the peak temperature or activation enthalpy for hydrogen relaxation in the Nb-10 at. % V alloy. The effects of oxygen and hydrogen on the tensile properties of the Nb-10 at. % V alloy were also studied. The addition of oxygen increases both the thermal and athermal stress components, although the effect is more pronounced on the thermal than on the athermal stress component. The 0.2% tensile yield stress is proportional to concentration as it is predicted for a concentrated solid solution. For the Nb-10 at. % V alloy containing hydrogen, alloy softening is observed at ~125°K regardless of the presence of oxygen. This behavior is explained by the stress-induced ordering of hydrogen atoms in this temperature range. The effect of hydrogen on the strengthening and ductility of this alloy is much more pronounced in the presence of oxygen than in the low oxygen alloy.

35141 (IS-T—1284) Solidification dynamics in binary alloy systems. Eshelman, M.A. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 282p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87010926.

Quantitative directional solidification experiments were carried out in transparent metal analog systems to examine linear and nonlinear theories of planar interface instability, to track the pattern formation process, to examine steady-state and dynamical processes in the cellular growth region, and to examine the effects of anisotropy of interface properties on growth morphologies. Studies of pattern formation show that the pattern formation process is not entirely caotic, but rather, a discrete set of transition wavenumbers exist during the pattern formation process. Studies in the cellular growth region show that the steady-state cellular spacing decreases, increases sharply, and again decreases as the velocity is increased from the point of planar interface instability to the maximum cell growth velocity. Dynamic experiments in the cellular growth region show that adjustment of the cell spacing requires drastic growth morphology changes when the growth conditions are changed slowly in systems where anisotropy of interface properties are present. Studies of the effects of anisotropy on solidification morphologies show that anisotropic interface properties cause cell translation parallel to an advancing solid-liquid interface when the [001] crystallographic direction is not in line with the heat flow direction.

35142 (LA-UR—87-1585) The rate dependence of structure evolution in copper and its influence on the stress-strain behavior at very high strain rates. Follansbee, P.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 14p. (CONF-8705109—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010114.

From IMPACT '87; Bremen, F.R. Germany (18 May 1987).

A model for the deformation of copper over a wide range of strain rates has been modified to account for the contribution of dislocation drag at high strain rates. The main effect of adding this mechanism is found in the near yield region at strain rates exceeding $10^3\ s^{-1}$. However, even at strain rates as high as $10^6\ s^{-1}$ the rate controlling deformation mechanism at strains greater than roughly ϵ=0.1 is thermal activation. It is postulated that the high stresses predicted at yield when the strain rates are raised above $10^3\ s^{-1}$ may lead to the rapid dislocation accumulation rates that have been found experimentally and which lead to the increased strain-rate sensitivity reported to copper and other metals at these strain rates.

35143 (LA-UR—87-1609) Shock wave effects and metallurgical parameters. Staudhammer, K.P. (Los Alamos National Lab., NM (USA)). 18 May 1987. Contract W-7405-ENG-36. 19p. (CONF-8705109—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010115.

From IMPACT '87; Bremen, F.R. Germany (18 May 1987).

This review summarizes results from some principal investigations of shock-strain effects in metals. The strain contribution indeed plays a role in residual microstructures, particularly, if the strain becomes dominant as in "under trapped" experiments of low or moderate pressure or for that matter, of "well trapped" high pressure experiments. Not only does this strain contribution affect the microstructure by increasing deformation, a concommitant strain heat is generated and absorbed by the shocked material. This strain heat, if large enough (relative to the homologous temperature of the material), can and does have an annealing effect on the residual microstructure. This strain heat is over and above the values typically calculated for materials implying little or no strain. Although the accumulative effects of associated strain are not completely definite, the collective picture presented is one in which shock-induced strains, when large enough, have a significant effect on the residual microstructure. 43 refs., 20 figs.

35144 (PB—87-180295/XAB) Study of defects in welded Zircaloy-4 using transmission electron microscopy. Shaikh, M.A.; Shoaib, K.A.; Khan, J.A.A.; Bukhari, S.J.H. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi. Nuclear Physics Div.). Jun 1985. 25p. (PINSTECH/NPD—116). NTIS, PC A02/MF A01.

Zircaloy-4 is used as a cladding material in Canada Deuteruim Uranium (CANDU) type nuclear power reactors. The technique of electron microscopy has been used for the investigation of microstructural defects produced in Zircaloy-4 due to the quenching treatment received during welding. Thes report describes the experimental results on the determination of Burgers vector of the dislocation loops. Identification of the nature of the defects, i.e., whether these are vacancy loops or hydride precipitates using electron-diffraction analysis, is discussed. Quantitative measurements of loop-size distributions and density of loops are reported. Variation of vacancy concentration with distance from the molten zone is also presented.

35145 (PNL-SA—14488) The need for microstructural control in coatings exposed to severe environments. Courtright, E.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 35p. (CONF-870388—9). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011149.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

Very fine grained or amorphous microstructures often improve the performance of coatings exposed to severe environments. Several examples are discussed to illustrate the desirability of controlling processing conditions to achieve microstructural control. In some cases, better environmental resistance is obtained from amorphous materials that exist in a metastable state of equilibrium. Since metastable phases are typically in a higher energy state, this observation is not intuitively obvious. For example, metastable glassy metal alloys exhibit significantly improved aqueous corrosion resistance. Here, the absence of grain boundaries appears to be the predominant factor. Very fine grained and amorphous optical coatings demonstrate improved laser damage resistance and better stability in the presence of humidity. It is suggested that compositional ho-

mogeneity is a principal factor in this performance. At high temperatures, the formation of protective glassy SiO_2 provides better oxidation protection than the stable, higher melting point refractories because the concentration of lattice defects in the crystalline oxides allows unacceptably high oxygen diffusion rates. Amorphous silica performs better until higher temperatures lower the viscosity and offset its advantage.

35146 **(SAND—87-1057C) Blacksmithing in a high-tech environment: "Under the spreading CNC mill the laboratories' smithy stands".** Gunter, R. (Lawrence Livermore National Lab., CA (USA)). 22 Apr 1987. Contract AC04-76DP00789. 30p. (CONF-8704116—1-Abst.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008518.

From IMOG metal forming modeling subgroup; Livermore, CA, USA (22 Apr 1987).

In some mass production processes, closed die forgings or drop forgings are applicable; however, the tooling costs and respective set-up times are generally quite high. Rarely does anyone in a prototype application ever think of heating a piece of stock to achieve thermally enhanced plasticity and then hand-hammering it on the anvil to form it to the desired shape. Yet at Sandia National Laboratories it has been found that a blacksmith shop complete with a coal fired forge, hammers, and anvil is a valuable asset, cost effective, and greatly enhances capabilities for producing prototype parts.

35147 **(SAND—87-1394C) Electron deformation density distribution in α-boron.** Will, G.; Kiefer, B.; Morosin, B.; Slack, G.A. (Bonn Univ. (Germany, F.R.). Mineralogisches Inst.; Sandia National Labs., Albuquerque, NM (USA); General Electric Co., Schenectady, NY (USA). Research and Development Center). 1987. Contract AC04-76DP00789. 6p. (CONF-870438—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010478.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

The bonding features of α-boron were studied using electron density analysis procedures. Deformation density maps and valence density were calculated and the structure analyzed by so-called multipole refinements, yielding R = 0.0119. The refinement model correctly describes the bonding and results in a difference density distribution free from any meaningful residual peaks.

35148 **(SAND—87-1430) Corrosion of ion implanted amorphous alloys.** Sorensen, N.R.; Diegle, R.B.; Picraux, S.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011061.

We are determining how alloy composition and structure interact to control the electrochemical behavior of amorphous alloys. Our program has two main goals: to understand how phosphorus influences the formation and breakdown of passive films on transition metal alloys, and to separate and quantify the individual roles of P and alloy structure in these processes. The work described herein primarily focusses on the first goal. We have investigated P implantation into Fe-Cr alloys at a sufficiently broad range of fluences to induce electrochemical effects resulting from the change in chemical composition, and also from the crystalline-to-amorphous structural transition.

35149 **(UCRL—96671) Phase stability by the artifical concentration wave method.** Jankowski, A.F.; Tsakalakos, T. (Lawrence Livermore National Lab., CA (USA); Rutgers--the State Univ., Piscataway, NJ (USA). Dept. of Mechanics and Materials Science). 22 May 1987. Contract W-7405-ENG-48. 19p. (CONF-8706103—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010877.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

Phase stability can be examined by means of concentration waves. X-ray diffraction techniques are utilized to study the growth and decay of the concentration waves, from which critical temperatures can be determined. Artifical composition modulated foils (of short period) examined include Cu/Ni, Cu/NiFe, Cu/NiCr, and Cu/NiSn. The theory of static concentration waves can be employed to predict phase structure, stability, critical temperature, and kinetics.

35150 **Effect of small amounts of hydrogen on the elastic behavior of lutetium.** Greiner, J.D.; Beaudry, B.J.; Smith, J.F. (Ames Laboratory, U. S. Department of Energy and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **62**: No. 4, 1220-1223(15 Aug 1987). Contract W-7405-ENG-82.

The elastic constants of a well-characterized, high-purity single crystal were measured before and after hydrogen was added to change the hydrogen content from 500 at. ppm (3 wt. ppm) to 6900 at. ppm (40 wt. ppm). Comparison between the two sets of measurements shows that such a small change in hydrogen content has a disproportionately large effect on the elastic stiffness. In this case the increase in hydrogen content produced an increase in all directly measured elastic constants by the order of 0.5%. Further comparison of our data with earlier data indicates that other interstitial elements (e.g., C, N, and O) may also exert an inordinately large influence on the elastic stiffness.

35151 **New system for vacuum deposition of refractory materials using an atmospheric-pressure inductively coupled plasma.** Merkle, B.D.; Kniseley, R.N.; Schmidt, F.A. (Ames Laboratory, U.S. Department of Energy, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **62**: No. 3, 1017-1021(1 Aug 1987). Contract W-7405-ENG-82.

We have successfully developed a technique utilizing an atmospheric-pressure inductively coupled plasma combined with a low-pressure deposition chamber for deposition of thin films. The equipment and method of operation are discussed. Refractory powders (Nb and Y_2O_3) were injected into the plasma and deposited as Nb and substoichiometric yttrium oxide, YO/sub 1.49/, onto Fe and Cu substrates. The substoichiometric yttrium oxide deposit adhered well to the Fe and Cu substrates, while the Nb deposit adhered well to the Fe only. The Nb deposit on the Cu substrate flaked and peeled probably because of stresses induced from the thermal expansion mismatch between the Nb and Cu. Further studies will be undertaken to better understand the processes occurring in this type of plasma-coating system in order to optimize the instrumental parameters for particular coating applications.

35152 **Suppressed kinetics of short range ordering at low temperatures.** Fultz, B. (Division of Engineering and Applied Science, California Institute of Technology, Pasadena, California 91125). *Journal of Chemical Physics;* **87**: No. 3, 1604-1609(1 Aug 1987).

The kinetics of short range ordering in a binary alloy were studied by Monte Carlo simulation. Unlike the kinetics of ordering by the direct interchange of atoms, at low temperatures there is a marked suppression of the kinetics of ordering when ordering occurs by the vacancy mechanism. Large activation energies are associated with this suppression of kinetics. These activation energies suggest that certain heterogeneities in the atomic arrangements on the lattice behave as traps which the vacancy cannot easily escape at low temperatures. Such traps were observed during simulations of the ordering process.

35153 **Unlubricated friction and wear of an ion beam mixed, nitrogen-implanted $Fe_{50}Ti_{50}$ surface alloy on AISI 304 stainless steel.** Hirvonen, J.; Nastasi, M.; Mayer, J.W. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14853). *Applied Physics Letters;* **51**: No. 4, 232-234(27 Jul 1987).

Nitrogen implantation was observed to significantly improve the dry sliding properties of an ion beam mixed $Fe_{50}Ti_{50}$ surface alloy on AISI 304 stainless steel. Implantation to the fluence of 1.7 x 10^{17} N/cm^2 at 50 keV increased the wear resistance but a decreased friction coefficient was obtained only after few hundred cycles at the beginning of the pin-on-disk test. When nitrogen was implanted to the fluence of 3 x 10^{17} N/cm^2 an improved wear resistance and decreased friction were detected throughout the test of 1000 cycles. In addition, good sliding properties were also found at higher loads in the high fluence, nitrogen-implanted samples. These

results differ from those obtained following a nitrogen implantation into Ti-implanted iron or iron-based alloys and are attributed to higher titanium and nitrogen concentrations.

35154 **Time dependent regular solution model for the thermal evaporation of an Al-Mg alloy.** Romig, A.D. Jr. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 2, 503-508(15 Jul 1987). Contract AC04-76DP00789.

A series of Al-6.27 at. % Mg alloys were thermally evaporated in a vacuum at 1910 K. The length of time during which the alloy was molten and was evaporating was varied from very short times to a length of time sufficient for complete evaporation of the alloy. The thickness and average composition of the deposited films were determined with thin-film x-ray microanalysis in the analytical electron microscope. A solution/flux model was developed to simulate the evaporation process. The model treated the liquid Al-Mg alloy as a regular solution using experimentally determined Raoultian activity coefficients. The evaporative flux was calculated according to the expression of Langmuir. The solution and flux equations were numerically integrated with respect to time to accommodate changes in mass and liquid alloy composition as the molten alloy evaporated. The agreement between the model and the experimental data (evaporation rate, rate of composition change in the molten alloy, film thickening rate, and average film composition) was excellent. The experimental data and the results of the solution/flux model show that the Mg is evaporated from the melt very quickly. The time required for Mg depletion is approximately 3% of the time required for total evaporation of the alloy. The solution/flux model calculates an average activation energy for evaporation of 72 400 +- 4000 cal/mol over the temperature range 1800—2400 K, which is in good agreement with the thermodynamic enthalpy change for vaporization of 72 300 +- 2000 cal/mol at 2110 K.

35155 **Soft x-ray scattering from rough surfaces: experimental and theoretical analysis.** Hogrefe, H.; Kunz, C. (University of Hamburg, II. Institute for Experimental Physics, D-2000 Hamburg 50, Federal Republic of Germany). *Applied Optics;* **26**: No. 14, 2851-2859(15 Jul 1987).

Specularly reflected and scattered radiation at $\lambda = 50$, 100, 200 A from artificially roughened flat mirrors and from thick vacuum evaporated Au samples. The results of the roughened samples are in reasonable agreement with Beckmann's scalar theory using an exponential autocorrelation function. The angle-dependent scattering distributions at different angles of incidence and different wavelengths are described with a unique mean roughness and autocorrelation length. Some small discrepancies remain because the scalar theory does not take into account the optical constants of the scattering surface. The use of vector theory in its simplest analytical form is not successful; however, it provides a means to qualitatively correct the scalar theory for the influence of the actual optical constants in agreement with our experiments. The thick Au films are roughened by surface crystallization and yield completely different scattering distributions. These results could not be fitted to scalar theory, either with an exponential or a Gaussian autocorrelation function.

35156 **Compositional analysis of the rhodium metal-oxide interface by imaging atom-probe mass spectroscopy.** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 2, 100-102(13 Jul 1987). Contract AC04-76DP00789.

The chemical composition of a thin rhodium oxide from the surface through the metal-oxide interface has been measured by imaging atom-probe mass spectroscopy. The surface oxide was produced by heating a clean, well-characterized field-emitter surface to 600 K in 1 Torr O_2 for 15 min. The oxidized sample was subsequently transferred under ultrahigh vacuum to an imaging atom probe for analysis. To avoid problems associated with a nonuniform oxide layer, only a small volume of the oxide layer was mass analyzed. The results indicated that under these conditions 50—60 layers of stoichiometric Rh_2O_3 are produced with dissolved oxygen (possibly mixed with substoichiometric oxides) extending an additional 5—15 layers into the bulk. A small amount of H_2O was detected within the oxide with an enhanced concentration observed at the interface.

35157 **Propagating spin waves in Ni above T/sub c/: Evidence against their existence.** Shirane, G.; Boeni, P.; Martinez, J.L. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **36**: No. 1, 881-883(1 Jul 1987).

We have reexamined the spin-wave peaks recently reported by Mook and Lynn for Ni above T/sub c/. We present comprehensive neutron scattering measurements for the intermediate zeta range between 0.10 and 0.18. No evidence for spin-wave peaks is found for the energy range below 50 meV.

35158 **Composite thin-film production by ion bombardment.** Carr, W.; Seidl, M.; Tompa, G.S.; Souzis, A. (Physics Department, Stevens Institute of Technology, Hoboken, New Jersey 07030). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 1250-1253(Jul 1987).

Composite thin-film production by low-energy cesium ion bombardment was investigated. An ion beam impinging on a target produces a steady-state film, with a total dose of less than 10^{16} ions/cm^2. The fractional concentration of the beam species depends on the incident energy. When the incident energy is sufficiently low, the surface binding energy is greater than the recoil energy and an overlayer forms. An analytical model describing the steady-state film, including sputtering, backscattering, implantation, and diffusion is given. In the absence of diffusion the surface concentration depends on the ratio of the implanted fraction to the target sputtering yield. When diffusion is important, the depth profile becomes exponential and the surface concentration is reduced.

35159 **Growth and stability of Ag layers on Cu(110).** Taylor, T.N.; Hoffbauer, M.A.; Maggiore, C.J.; Beery, J.G. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 1625-1629(Jul 1987).

Combined surface science and high-energy ion beam techniques have been used to characterize the composition, structure, and thermal stability of Ag layers <900 A thick on Cu(110). A uniform Ag/Cu surface composite is formed for one-monolayer coverage. Analysis of its growth with low-energy electron diffraction shows that the Ag is initially confined to the [11-bar0] troughs and that further deposition results in a Ag(111) layer exhibiting c(2 x 4) symmetry. This determination of Ag coverage is consistent with absolute coverages measured with Rutherford backscattering. Beyond one-monolayer coverage, the deposition of Ag at 300 K produces clustering (Stranski—Krastanov mechanism) in contrast to a poorly ordered but more uniform layering mode when deposited at 130 K. Following nucleation for a deposition between one and two monolayers at 300 K, Ag clusters —20 A thick grow laterally across the surface up to five- or six-monolayers deposition. Continuous films grown cold at thicknesses $\leq$115 A are found to agglomerate above 500 K exposing a tenacious Ag—Cu interface like that formed by one-monolayer Ag deposition.

35160 **Study of ion plating parameters, coating structure, and corrosion protection for aluminum coatings on uranium.** Egert, C.M.; Scott, D.G. (Materials Engineering Department, Development Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2724-2727(Jul 1987).

A study of ion-plating parameters (primarily deposition rate and substrate bias voltage), coating structure, and the corrosion protection provided by aluminum coatings on uranium is presented. Ion plating at low temperatures yields a variety of aluminum coating structures on uranium. For example, aluminum coatings produced at high deposition rates and low substrate bias voltages are columnar with voids between columns, as expected for high-rate vapor deposition at low temperatures. On the other hand, low deposition rate and high bias voltage produce a modified coating with a dense, noncolumnar structure. These results are not in agreement with other studies that have found no relationship between deposition rate and coating structure in ion plating. This discrepancy is probably due to the high deposition rates used in these studies. An

accelerated, water vapor corrosion test indicates that the columnar aluminum coatings provide some corrosion protection despite their porous nature; however, the dense noncolumnar coatings provide significantly greater protection. These results indicate that ion-plated aluminum coatings produced at low deposition rates and high substrate bias voltages creates dense coating structures that are most effective in protecting uranium from corrosion.

35161 **Magnetic enhancement of cathodic arc deposition.** Sanders, D.M.; Pyle, E.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2728-2731(Jul 1987).

Cathodic arc deposition offers some important strengths as a deposition process. Material can be deposited at extremely rapid rates and large fractions of the evaporant are ionized, permitting control of the arrival energy of the depositing material. In addition, the depositing material can be directed by magnetic and electrostatic fields to specific locations within the chamber. In the present study, magnetic fields were used to achieve such control of a copper plasma, leading to a fourfold enhancement in the effective deposition rate and a simultaneous improvement in coating adhesion.

35162 **Field ion microscope observations of the reconstruction of platinum and iridium surfaces.** Kellogg, G.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 747-750(Jul 1987). Contract AC04-76DP00789.

The thermal reconstruction of various Pt and Ir single-crystal surfaces has been studied in atomic detail with the field ion microscope. Unreconstructed surfaces, which were produced by low-temperature field evaporation, were induced to reconstruct by heating the field-ion samples under field-free conditions. As previously reported for Pt, the (110) surface of Ir was observed to reconstruct from a bulk-terminated structure to a structure consisting of missing rows of atoms. The transition took place at a temperature of 500 K, almost 200 K higher than that found for Pt. The (311), (511), and (211) planes of Pt also reconstructed to missing rows at temperatures above 400 K. Transitions from field-evaporated structures to new structures (identified as reconstructed) were also observed on Pt(100) and Ir(100) at temperatures of 270 and 470 K, respectively, but the field ion images did not exhibit sufficient resolution to identify the atomic structure of the reconstructed surfaces.

35163 **Effect of interaction range on the W(001) surface reconstruction phase transition.** Roelofs, L.D.; Wendelken, J.F. (Fritz-Haber Institut, 4-6 Faradayweg, D-1000 Berlin 33, Federal Republic of Germany). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 768-770(Jul 1987).

A model for the W(001) surface reconstruction phase transition is studied to elucidate the dependence of transition temperature on interaction range and other model parameters. We find that for the parameter set chosen extending the range of the interaction without changing the total reconstruction energy increases the model transition temperature somewhat. This reduces a previously reported discrepancy between the experimental transition temperature and that consistent with the calculated reconstruction energy, but only marginally.

35164 **Impact of step edges on W(001) surface reconstruction.** Zuo, J.; Lu, T.; Wang, G.; Wendelken, J.F. (Department of Physics, Rensselaer Polytechnic Institute, Troy, New York 12180-3590). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 777-781(Jul 1987).

Step edges on the W(001) surface can inhibit the reconstruction of the surface at low temperatures. However, the range of this inhibition, an important parameter for theoretical consideration, has been a matter of controversy. In this paper, we report our study on the impact of step edges on both the clean surface and H-induced reconstructions on the monotonically stepped W(001) surfaces using low-energy electron diffraction. First, the spread of the terrace widths which manifests itself as the broadening of the individual splitting beams from two high-density stepped W(001) surfaces (29- and 36-A average terrace widths) was obtained by quantitative analysis of the angular intensity distribution of the splitting beams. The spread was found to be —13 A for both stepped surfaces assuming a Gaussian terrace width distribution. Second, based on the spread of the terrace width and an assumed inhibition range the reconstruction domain size distributions were obtained by comparing the calculated and measured angular profiles of the superlattice beams (which do not split due to the random antiphase relationship among the domains) from both surfaces. The deduced inhibition range was 8 +- 2 A for both clean and H-induced reconstruction surfaces. These results contradict the findings of King and of Bauer and co-worker who suggested a long-range (≧20 A) inhibition. Possible explanations of the discrepancy will be presented.

35165 **Removal of surface relaxation of Cu(110) by hydrogen adsorption.** Baddorf, A.P.; Lyo, I.; Plummer, E.W.; Davis, H.L. (Department of Physics, Unversity of Pennsylvania, Philadelphia, Pennsylvania). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 782-786(Jul 1987).

It is now established that the termination of a metal crystal by a vacuum causes oscillatory relaxation of the interplanar distances near the surface, even when there is no lateral reconstruction. Since the details of the driving forces for this oscillatory relaxation are not fully understood at the present time, we have undertaken low-energy electron diffraction (LEED)—IV experiments and calculations to study the structure of(1 x 1) Cu(110) as a function of atomic hydrogen concentration adsorbed at 90 K. At this temperature high-resolution electron energy-loss spectroscopy reveals that the hydrogen lies in inhomogeneous sites within the (110) troughs. At most coverages LEED indicates that the hydrogen is disordered. Hydrogen induced changes in the work function and in angle-resolved ultraviolet photoemission spectroscopy spectra are small, indicating a weak interaction between the hydrogen and copper substrate. This one-dimensional lattice gas causes a continuous shift in the Cu(110) interplanar distances, resulting eventually in a bulk lattice spacing between the top two layers. Subsurface lattice spacings change at a slower rate. We conclude that the simple model of an electrostatic driving force created by a lateral charge redistribution [see M. W. Finnis and V. Heine, J. Phys. F 4, L37 (1974)] can explain the nature of the experimental results. The adsorption of hydrogen reduces the charge-density corrugation of the surface, and eliminates the charge redistribution and related surface relaxation of the copper substrate.

35166 **Measurements of weakly bound hydrogen on Pd(111) between 5 and 80 K.** Stulen, R.H.; Kubiak, G.D. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 535-537(Jul 1987).

The adsorption of hydrogen and deuterium onto a low-temperature surface of Pd(111) has been studied experimentally using electron-stimulated desorption (ESD) and temperature programmed desorption spectrometry (TPD). At a surface temperature T/sub S/ = 7.5 +- 1 K, exposure to D_2 leads to multilayer formation which is reflected in the desorption of deuterium ion clusters D^+/sub n/ by ESD (E/sub e//sub =/ = 100 eV). Cluster sizes up to n = 21 have been observed which, except for n = 2, consist exclusively of odd numbers of atoms. The temperature dependence of the ESD signal following exposure at T/sub S/ = 7.5 +- 1 K suggests that by 9.5 +- 1 K the multilayer desorbs leaving a diatomic molecular species which, in the high-coverage limit, is stable up to —20 K. Exposure to hydrogen at these low temperatures gives rise to two TPD peaks: the β (chemisorption) peak and a new TPD peak denoted γ (near 60 K at low coverage) which is assigned to desorption of a surface molecular hydrogen species. Mixed isotope experiments show that there is no mixing in the γ state consistent with this assignment. With increasing exposure, the γ peak grows in intensity and shifts rapidly towards lower temperature. TPD peak shape analysis gives a binding energy for the molecular state at low coverage of —0.020 +- 0.010 eV and a corresponding preexponential of approximately 10^{13} s^{-1}.

35167 Rehybridization of CO with K coadsorption on Ru(001). Jennison, D.R. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 684-687(Jul 1987). Contract AC04-76DP00789.

The recently observed "rehybridized" CO, produced by coadsorption with (1)/(3) monolayer of potassium on Ru(001), is studied by cluster calculations. The photoemission and Auger spectroscopic results are consistent with the effects produced by the strong electric field in an ionic K—CO local complex in which the σ orbitals are indeed rehybridized and the 1π level is split. The experiments are not consistent with an sp^2 hybridized >C—O species or a (CO)/sup 2-/$_2$ potassium salt. A long-range electric field arising from hypothetically positive potassium also produces electronic changes in the wrong direction to explain the spectra.

35168 Two-photon photoelectron spectroscopy of Pd(111). Kubiak, G.D. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 731-734(Jul 1987).

Angle-resolved two-photon photoelectron spectroscopy has been used to study the normally unoccupied band structure of Pd(111). Photoemission features are studied as functions of excitation photon energy $h\nu$, polarization state, and emission angle. Below $h\nu = 4.9$ eV, photoemission is dominated by excitation of bulk states near the Fermi level of Λ_3 symmetry through Λ_1 excited states between the Fermi and vacuum level. The kinetic energy of the corresponding spectral peak is found to increase according to 2 hν-Phi, where Phi is the Pd(111) work function. At $h\nu = 4.9$ eV, a surface state with 0.65 +- 0.1 eV binding energy is found. The dispersion of this state with k/sub parallel/ is well-described by an effective mass m* equal to the free electron mass m/sub e/. This state is assigned as the $n = 1$ member of the image potential series of states. The relationship between the dispersion of this state and its position in the (111) projected bulk band gap is discussed.

35169 Synchrotron radiation photoemission studies of CO chemisorption on Pt/Ta(110) and Ni/Ta(110). Ruckman, M.W.; Strongin, M.; Pan, X. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 805-809(Jul 1987). Contract AC02-76CH00016.

The effect of overlayer structure and electronic density near the Fermi level on CO chemisorption is studied for Pt or Ni deposited on Ta(110) using angle-resolved synchrotron radiation photoemission spectroscopy. Pt films form two-dimensional pseudomorphic islands at submonolayer coverage, but undergo a structural change to a close-packed Pt(111)-like structure at —0.7 monolayer coverage. Absence of CO induced photoemission features at monolayer coverage suggests that the CO—Pt bond has been weakened and this prevents the retention of CO on a close-packed Pt monolayer at room temperature. Close-packed Pt films three or more layers thick readily chemisorb CO. At liquid-nitrogen temperature, CO is retained on Pt/Ta(110), and photoemission features, such as the CO 4σ shake-up satellite seen for weakly bonded CO on noble metals, appear for the CO phase chemisorbed on a Pt monolayer. This photoemission feature is absent for CO chemisorbed on thicker Pt films. Photoemission examination of the CO—metal bonding geometry suggests that the CO molecules lie close to the surface normal for both Pt monolayers and the thicker Pt films. From the photoemission data, we conclude that the CO—metal bond strength is reduced for CO—Pt/Ta(110). Comparable studies of CO on Ni/Ta(110) were not possible because the three-dimensional clustering of Ni produced a more complicated surface which had a number of inequivalent CO bonding sites.

35170 Surface electronic behavior of face-centered-cubic iron on copper. Fernando, G.W.; Lee, Y.C.; Montano, P.A.; Cooper, B.R.; Moog, E.R.; Naik, H.M.; Bader, S.D. (Department of Physics, West Virginia University, Morgantown, West Virginia 26506). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 882-886(Jul 1987).

We have studied the electronic structure of fcc iron grown epitaxially on (100) copper with ultraviolet photoemission (UPS), surface magneto-optic Kerr effect (SMOKE), low-energy electron diffraction (LEED), and self-consistent film linearized muffin-tin-orbital (FLMTO) calculations. This study identifies and explains novel characteristic UPS features of fcc iron and a substantial change in the work function compared to bcc iron. The SMOKE measurements show that fcc iron grown on copper has two metastable states lying close in energy. One of these is not ferromagnetic and occurs at room temperature, while the other is ferromagnetic and occurs at 190 °C. As shown by LEED, the ferromagnetic state has an expanded surface interplanar lattice; and UPS shows exchange splittings in that state.

35171 Effects of Na on the interaction of CO with Ta(110). Shek, M.L.; Pan, X.; Strongin, M. (Brookhaven National Laboratory, Upton, New York 11973). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 1057-1060(Jul 1987). Contract AC02-76CH00016.

The interaction of CO with Ta(110) at 80 K proceeds by dissociative chemisorption followed by molecular adsorption. The molecular chemisorption bond strength is weak, as judged by the observation in photoemission spectra of a "shake-up" feature at 2.1 to 2.2 eV below the "4σ" orbital. The weakly bound molecular phase continues to exist in the presence of Na predoses, apparently without appreciable adsorption bond strengthening. This molecular phase is suppressed in favor of dissociation only after predoses of —1.0 and —1.29 ML Na, when a small to moderate enhancement in CO dissociation occurs relative to the pure surface at 80 K.

35172 Isothermal desorption spectroscopy of CO from epitaxial (111) Pd/mica films. Gotoh, Y.; Vook, R.W.; Morales De La Garza, L.; Pan, Y. (Laboratory for Solid State Science and Technology, Physics Department, Syracuse University, Syracuse, New York 13244-1130). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 1863-1866(Jul 1987).

An isothermal desorption spectroscopy study of carbon monoxide adsorbed on clean, vapor deposited, epitaxial (111) Pd films grown on mica was carried out using Auger electron spectroscopy (AES) techniques. Saturation CO coverages were obtained at room temperature and followed by AES peak-to-peak height measurements as a function of time at elevated temperatures ranging from 90 to 130°C. Data analysis was carried out using first-order kinetics that yielded an activation energy for desorption E/sub d/ = 24.0 +- 0.3 kcal/mol. This value was found to apply to surface coverages ranging from saturation down to a few percent of saturation at the higher temperatures used. Previous studies by others on (111) Pd surfaces using flash desorption and contact potential methods have shown that at low coverage the desorption energy is —34 kcal/mol; but that as saturation coverage is approached, the desorption energy drops sharply to 22—24 kcal/mol. The present isothermal annealing results on epitaxial thin films are thus in agreement with previous near saturation coverage results using different methods. However, the present work indicates a constant desorption energy as the coverage decreases to values that are small fractions of saturation.

35173 Experimental studies of the electronic structure of I—II and I—III intermetallic compounds with B32 (Zintl) structure. Curelaru, I.M.; Din, K.; Jang, G.; Chen, L.; Wall, E.; Susman, S.; Brun, T.O.; Volin, K.J.; Koch, E.; Horn, K. (Department of Materials Science and Engineering, University of Utah, Salt Lake City, Utah 84112). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2038-2041(Jul 1987).

Photoemission and electron energy-loss data are reported for a series of I—II and I—III intermetallic compounds with B32 (Zintl) structure (LiAl, LiGa, LiIn, and LiZn). The structure of the valence band of LiAl, LiGa, and LiIn agrees well with theoretical relativistic augmented plane-wave (RAPW) band-structure calculations, while LiZn deviates appreciably from theory. Binding in Zintl phases is confirmed to be achieved through s-to-p charge promotion at both Li and the second metal, rather than by Li—Me(II, III) charge transfer. The rich near-edge x-ray absorption fine structure at the Li-1s absorption edge, and an interband transition ob-

served in electron-energy loss spectra also support the RAPW predictions for the structure of the empty band. The plasmon energy in LiAl is equal to that calculated for free electrons, and its value is insignificantly affected by the defect structure of the LiAl lattice.

35174 **Measurement of the hydrogen recombination coefficient for ZrAl.** Knize, R.J.; Emerson, L.C.; Cecchi, J.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2202-2204(Jul 1987).

The hydrogen recombination coefficient for ZrAl was measured over a temperature range of 450 to 650°C. The measured values were found to be in good agreement with the values calculated using a previously described theory, along with other measurements. This present measurement technique for determination of the hydrogen recombination coefficient can also be applied to other materials.

35175 **Accurate sorption isotherms using a computer-aided microgravimetric method.** Thompson, K.A.; Fuller, E.L. Jr. (Plant Laboratory, Oak Ridge Y-12 Plant, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2522-2525(Jul 1987). Contract AC05-84OR21400.

Sorption isotherms are routinely acquired for surface area and porosity measurements, but often with less detail than desired for accurate determinations, to measure kinetics, or to compare to new theories. More care is needed to reduce errors and to increase the number of acquisition points. The gravimetric method has the versatility to measure mass, pressure, and temperature directly and independently. The method also has direct accountability; that is, not dependent upon previous measurements (compared to the volumetric method). To obtain more detailed sorption isotherms, a high-vacuum microbalance was designed and interfaced with a minicomputer that controlled all aspects of the data acquisition, which includes mass, pressure, and temperature readings, and storage as well as pressure and temperature control (and filling the bath, if required). The system was successfully tested by initially acquiring nitrogen and argon sorption isotherms for a commercially available alumina catalyst using both gases in condensed form for the sample bath. The nitrogen sorption isotherm compared favorably with data acquired volumetrically. Although nitrogen at 77 K has become the favored standard, argon at 88 K would seem to have some advantages, particularly being monoatomic and having no quadrupolar moment. Other comparisons are given, and the merits of the automated high-vacuum microbalance become quite evident when nonroutine, detailed exploratory studies are required.

35176 **Hydrogen permeation apparatus with surface modification and characterization capabilities.** Swansiger, W.A.; Folk, D.R. (Sandia National Laboratories, Livermore, California 94550). *Review of Scientific Instruments;* **58**: No. 7, 1266-1270(Jul 1987). Contract AC04-76DP00789.

A new ultrahigh-vacuum hydrogen permeation system is described which permits modification and characterization of the sample surface while the permeation experiment is in progress. The sample cell is mounted on a manipulator which allows it to be moved to various stations within the vacuum chamber. The sample can be modified by: (1) argon sputter cleaning; (2) sputter deposition of various materials; (3) chemical vapor deposition; and (4) exposure to various gases using a doser. XPS and AES are used for in situ surface characterization. For most experiments the inside of the sample cell is pressurized with hydrogen or deuterium and the effects of modifying the downstream surface are monitored using a quadrupole mass spectrometer, which measures the permeating flux. It is also possible to measure permeation in the opposite direction by sealing a cell to the UHV face of the sample assembly and pressurizing it with tritium. Results are reported for the permeation of deuterium through polycrystalline iron as a function of the AES oxygen to iron ratio. As the O/Fe ratio increased to 1.5, the deuterium permeability decreased by a factor of 14 at 313 K.

35177 **Structure-property relations for surface processes at the metal/solution interface.** Ross, P.N. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 948-953(Jul 1987). Contract AC03-76SF00098.

The recent development of special apparatus coupling electroanalytical cells directly to UHV surface analytical chambers has made possible definitive determination of structure-property relations for processes at metal electrode surfaces. Low-energy electron diffraction analyses of emersed platinum electrodes have provided direct evidence for place-exchange processes accompanying anodic oxidation, and combined with recent x-ray photoelectron spectroscopy and thermal desorption spectroscopy results these studies have refined our understanding of aqueous oxidation phenomena. The use of UHV annealed well-ordered single-crystal surfaces has produced some surprising results. The process of submonolayer metal ion deposition (so-called underpotential deposition) exhibits unexpected sensitivity to long-range order in the substrate, indicating that lateral bonding forces are of the same magnitude as the perpendicular bonding force. On a well-ordered Pt(111) surface, unexpected new surface processes have been observed that are unique to this surface, i.e., are not seen on either (100) or (110) surfaces, nor on polycrystalline surfaces. It appears that the new processes are associated with atomically flat regions of the (111) surface with a critical region size that is quite large, at least 2 nm. It is suggested that cooperative interactions in the double layer form a critical ensemble that react to form the new surface species. However, much further study utilizing in situ spectroscopy will be required to understand this new surface process in Pt(111).

35178 **Surface analysis and electrochemical studies of sulfur enhanced corrosion of nickel.** Baer, D.R.; Danielson, M.J. (Pacific Northwest Laboratory, Richland, Washington 99352). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 1147-1151(Jul 1987). Contract AC06-76RL01830.

A combined surface analysis and electrochemical study of sulfur implanted nickel has examined the lifetime and mobility of sulfur on the surface and in an acid solution. X-ray photoelectron spectroscopy and Auger electron spectroscopy have been used to examine the chemistry, location, and amount of sulfur on the surface and in films formed on the implanted nickel in a 0.5N nitric acid solution at various electrochemical potentials. Specimens were prepared in a low-oxygen partial pressure glove box and transferred to the spectrometer in an anaerobic transfer vessel. Although most sulfur is removed from the implanted nickel during rapid dissolution, a submonolayer of sulfur remains on the surface in "sulfide" form in the active region of potential. Upon exposure to higher oxidizing potentials, some of the sulfur is oxidized and both sulfate and sulfide are found in the film. Recycling the film back to the active region removed some of the oxidized sulfur, but much of the sulfur remains on the surface. Sulfur transfers through the solution to nearby materials, where it appears on the surface in both sulfide and sulfate states. Current studies suggest only a very slow oxidation of sulfur on the surface or in solution.

35179 **Oxidation kinetics for thin rare-earth metal films.** Burnham, A.K.; Jameson, G.T. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 1713-1716(Jul 1987). Contract W-7405-ENG-48.

We measured the oxidation rates of thin samarium, gadolinium, ytterbium, and yttrium films at room temperature in air by a simple optical transmission technique to help understand how to produce flat 100 nm or so thick films on 150-nm freestanding polymer substrates for use as x-ray lasers. The validity of the method is established with aluminum, whose oxide layer reaches a limiting thickness of about 5 nm within 1 h. The oxidation kinetics of different rare earths follow different rate laws. Ytterbium and gadolinium are best described by an inverse logarithmic rate law, yttrium by a direct logarithmic rate law, and samarium by a parabolic rate law. After 2 months, the oxide thicknesses of Y, Yb, Gd, and Sm are about 5, 9, 15, and 17 nm, respectively. Only Sm continues to oxi-

dize rapidly, reaching 35 nm in 6.5 months. Spectroscopic results on Eu and Gd are consistent with previous results that the oxidized layer on the rare earths is usually a carbonated hydroxide. The results of our measurements are compared to those from initial oxidation studies by surface analysis techniques and high-temperature gravimetric studies.

35180 Coverage dependence in the electron-stimulated desorption of neutral NO from Pt(111). Burns, A.R.; Jennison, D.R.; Stechel, E.B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 671-674(Jul 1987). Contract AC04-76DP00789.

We report a strong coverage dependence in the yield of a neutral molecule desorbed by low-energy excitations produced by electron impact. For NO/Pt(111), there are two distinct desorption channels revealed by state-specific translational energy distributions, measured by time-of-flight laser resonance ionization. The dominant low-energy channel (E/sub trans/ = —0.05 eV) has been previously assigned to a simple 5σ excitation. The high-energy channel (E/sub trans/ = —0.35 eV) involves complex (multielectron) excitations. Here we present the coverage dependence of the specific yield for the two channels. Strikingly different behavior is seen in that a strong inverse dependence occurs for low-energy NO but relative independence of coverage is seen for high-energy NO. A model is developed which describes the coverage dependence in terms of varying localization (or self-trapping) probabilities as a function of nearest-neighbor site occupancy. Comparison to experiment using a random vacancy model is rather good, with deviations from randomness consistent with higher coordination than random at intermediate coverages.

35181 Cascade-driven migration of structural interfaces: A new type of irradiation-induced phase transformation. Allen, C.W.; Rehn, L.E.; Wiedersich, H. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **50**: No. 26, 1876-1878(29 Jun 1987). Contract W-31-109-ENG-38.

In Ti-Cr alloys containing both the Laves phase (ordered $TiCr_2$) and the β phase (bcc solid solution), 1 MeV Kr^+ irradiation at temperatures <250 K amorphizes the Laves phase but not the β phase. The irradiation-induced amorphous material transforms into polycrystalline β upon warming to room temperature. In contrast, irradiation at room temperature causes the β phase to grow by migration of the β/Laves interface; no change in local composition across the migrating interface is observed. The β phase also grows during prolonged irradiation at 100 K, but the velocity of the β/amorphous interface per unit calculated atomic displacement rate is more than three orders of magnitude lower than that of the β/Laves interface at room temperature. An interpretation of this new type of irradiation-induced phase transformation is presented in terms of displacement cascade formation and dynamic recovery at the structural interface that exists between the two phases.

35182 Surface-structural analysis by use of spin-polarized low-energy electron diffraction: An investigation of the Cu(100) surface. Lind, D.M.; Dunning, F.B.; Walters, G.K.; Davis, H.L. (Departments of Physics and of Space Physics and Astronomy, and the Rice Quantum Institute, Rice University, Houston, Texas 77251). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 17, 9037-9044(15 Jun 1987).

A detailed theoretical and experimental study of the Cu(100) surface using spin-polarized low-energy electron diffraction (SPLEED) is reported. An R-factor analysis of the present SPLEED data for the 10, 20, and 11-bar beams provides evidence of multilayer relaxation in Cu(100), and suggests that the first and second interlayer spacings deviate by -1.2% and +0.9%, respectively, from the bulk value. The present structural conclusions are in accord with those deduced in earlier LEED I-V studies, and suggest that combined measurements of spin-asymmetry and intensity profiles should provide an improved basis for structure determinations on surfaces of greater complexity.

35183 Development of a three-dimensional valence-band structure in Ag overlayers on Cu(001). Tobin, J.G.; Robey, S.W.; Klebanoff, L.E.; Shirley, D.A. (Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720; Departments of Chemistry and Physics, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 17, 9056-9066(15 Jun 1987).

Using monochromatic synchrotron radiation over the energy range of 6—32 eV, the development of the valence-band electronic structure of Ag overlayers on Cu(001) was followed with angle-resolved photoelectron spectroscopy. The d-band electronic structure was observed to be two dimensional for a single adlayer of c(10 x 2)Ag/Cu(001). With five layers of coverage, the silver valence-band structure was bulklike, three-dimensional, and very similar to that of Ag(111).

35184 Search for charge-density waves in a single crystal of potassium. You, H.; Axe, J.D.; Hohlwein, D.; Hastings, J.B. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 17, 9333-9336(15 Jun 1987).

We have searched for charge-density-wave (CDW) satellites in a single crystal of potassium at 10 K using synchrotron x rays. The satellite positions reported by Giebultowicz, Overhauser, and Werner were studied at a sensitivity of 10/sup -7/ of the (110) Bragg peak. No CDW satellites were observed, thereby setting an upper limit on the combination of width and intensity within the reciprocal space probed in this study.

35185 Numerical simulation studies of peripheral roughening in a monolayer. Ramirez, R.; Schneider, M.; Rahman, A.; Schuller, I.K. (Facultad de Fisica, Universidad Catolica de Chile, Santiago 22, Chile). *Physical Review Letters;* **58**: No. 24, 2606-2606(15 Jun 1987).

A Comment on the Letter by J. KolXaczkiewicz and E. Bauer, Phys. Rev. Lett. 54, 574 (1985).

35186 Absorptance characteristics of silver and silver-on-copper mirrors. Kimura, W.D. (Spectra Technology, Inc., 2755 Northup Way, Bellevue, Washington 98004). *Applied Optics;* **26**: No. 12, 2450-2455(15 Jun 1987).

Glancing incidence absorptance measurements are performed on bare silver and bare silver with a copper underlayer mirrors. Measurements are at a laser wavelength of 0.5145 μm, angles of incidence from 0 to 89°, at both s and p polarizations. The increase in absorptance as a result of the mirrors tarnishing naturally in room air is measured over a period of 60 days. New and untarnished, the silver/copper mirror tends to have a higher absorptance at all angles of incidence compared with the silver mirror. Once exposed to room air the silver/copper mirror absorptance at normal incidence does not increase as rapidly over time as the silver mirror, which seems to indicate a greater resistance to tarnishing. However, at glancing incidence both mirrors appear to have similar tarnishing rates. After 60 days the absorptance of the silver/copper mirror has a lower absorptance at normal incidence than the silver mirror, but at glancing angles of incidence both tarnished mirrors have comparable absorptance values.

35187 Optical absorbance of silver ellipsoidal particles. Buncick, M.C.; Warmack, R.J.; Ferrell, T.L. (Department of Physics and Astronomy, University of Tennessee, Knoxville, Tennessee 37996). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 6, 927-933(Jun 1987).

We describe a simple technique for producing arrays of silver ellipsoidal particles with parallel principal axes. The optical absorbance of the silver ellipsoids produced by this technique was measured as a function of angle, polarization, and wavelength of the incident light. Calculations of the optical absorbance were made using nonretarded electrodynamics and the bulk optical constants for silver. The results of these calculations are shown to compare favorably with the experimentally observed absorbance.

35188 Ion-beam-induced formation of a stable phase at the expense of an otherwise dominant metastable phase. Lee, E.H.; Mansur, L.K. (Metals and Ceramics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Materials Research;* 2: No. 3, 291-293(May 1987). Contract AC05-84OR21400.

Thermal aging and irradiation experiments were carried out in Fe—Ni—Cr base alloys containing Ti or Nb as well as low levels of oxygen, nitrogen, and carbon. After aging, fine dispersions of TiC and NbC were formed. However, after irradiation the Ti-containing alloy precipitated Ti(N,O) rather than TiC, while the Nb-containing alloy precipitated NbC. Analysis of the energetics of these reactions reveals that the Ti(N,O) phase is thermodynamically more stable than the TiC phase, while the NbC phase is more stable than the NbO phase. These results are therefore consistent with observed behavior. While it is well known that irradiation can drive a system away from equilibrium, the present results show that irradiation also can catalyze the formation of a more stable phase at the expense of a persistent metastable phase.

35189 Hydrogen concentration gradients in cathodically charged austenitic stainless steel. Ulmer, D.G.; Altstetter, C.J. (Department of Materials Science and Engineering, University of Illinois, Urbana, Illinois 61801). *Journal of Materials Research;* 2: No. 3, 305-312(May 1987).

An x-ray diffraction technique has been developed to make in-situ measurements of hydrogen concentration profiles from which diffusivity and solubility values are calculated. Hydrogen is supplied to the metal surface by cathodically polarizing it in a bath of 1N H_2SO_4 electrolyte. The incident x-ray beam penetrates a thin layer of electrolyte solution at the surface of the sample, thus, x-ray diffraction profile changes can be recorded as a function of charging time and temperature. The applied potential prevents outgassing of the specimen during the measurement. The x-ray diffraction profiles are deconvoluted to remove the α_1/α_2 doublet and noncompositional broadening effects. Composition-depth profiles are then obtained from an intensity band transformation of the deconvoluted data. A diffusion coefficient is determined by fitting a solution to Fick's second law to the concentration-depth profile. The technique described here was used to measure hydrogen diffusivity in stainless steel in the temperature range 20°—80 °C.

35190 Electropolishing applications in the nuclear industry. Allen, R.P. New York, NY; American Institute of Chemical Engineers (1986). 18p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017. Contract AC06-76RL01830.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Commercial electropolishing technology has been developed into a rapid, effective decontamination method that is used worldwide to decontaminate a variety of metallic components and structures. The prepolishing of surfaces to minimize contamination pickup and facilitate subsequent decontamination is a rapidly emerging technology that can be applied to large components using in situ techniques.

35191 First-principles study of phonon anomalies and the BCC-HCP Martensitic phase transition. Chen, Y. Ames, IA; Iowa State Univ. (1986). 111p. University Microfilms Order No. 87-03,693.Contract W-7405-ENG-82.

Thesis (Ph. D).

First principles total energy calculations were performed for Zr in the omega, bcc, hcp, fcc structures and for Ba in the bcc, fcc structures. From the calculations equilibrium lattice constants, cohesive energies, bulk moduli, and energy difference between the bcc and the hcp phases were obtained that are in good agreement with experiment. The total energy of the omega phase was found to be very close to that of hcp phase in Zr. Recent neutron scattering experiments on a single crystal of bcc Ba revealed that the longitudinal branch along the [100] directions is lower than the transverse branch. This anomalous behavior was studied with use of the frozen-phonon method and is shown to arise from d-electron interactions. For the pressure-induced bcc-hcp transition in Ba, the volume dependence of the complete energy surface from the bcc to the hcp structure was determined as a function of the atomic displacements corresponding to the T_1 N-point phonon mode and a long-wavelength shear. Results predict that the frequency of this phonon mode decreases with increasing pressure. For the temperature dependent bcc-hcp transition in Zr, the frozen phonon calculation results of the T_1 N-point phonon indicate an instability toward the formation of the hcp phase at T = 0 K.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 34839, 35097, 35097, 35131, 35151, 35156, 35243, 35408, 35525

35192 (AD-A—178079/0/XAB) Chemical bonding topology of superconductors. 2. Ternary lanthanide rhodium bordies. Technical report. King, R.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 6 Mar 1987. 13p. (TR—38). NTIS, PC A02/MF A01.

Graph-theory-derived methods are used to derive the chemical-bonding topology of the closed-shell rhodium boride building blocks of the superconducting lanthanide rhodium borides, (Ln = lanthanides such as neodymium, samarium, erbium, thulium, lutetium). The electronically linked three-dimensional lattice is by exotetrahedral Rh-Rh bonds. This work thus provides an example of an additional class of relatively high-temperature superconductors exhibiting porously delocalized chemical bonding topology like the Chevrel phases discussed in the previous paper of this series.

35193 (AD-A—178115/2/XAB) Investigation of the impact performance of various glass and ceramic systems. Annual report, July 1985-July 1986. Townsend, D.; Field, J.E. (Cambridge Univ. (UK). Cavendish Lab.). 27 Jan 1987. 54p. NTIS, PC A04/MF A01.

This report describes a study of the impact strength and fracture behavior of a range of ceramic materials. One part of the research is concerned with ceramics that have applications as radomes or infrared transmitting window materials, the other with ceramics with potential application in body armor. Ceramics included in the study include zinc sulfide, various glass ceramics and aluminas, silicon carbide, silicon nitride, titanium diboride, and boron carbide. In one series of experiments, the authors measured post-impact (i.e. residual) strength curves. These experiments involve impacting specimens at chosen velocities and then measuring the residual strengths after impact. Strength is plotted as a function of velocity. Such curves give: (i) the threshold velocity above which strength degradation following impact occurs; (ii) the fall in strength above the threshold; (iii) a ready comparison with other materials or between different batches of the same material which have had, for example, different surface preparations. From these strength curves, it is.....possible to estimate the size of the flaws that control the damage. Microscopy studies of the fracture faces were made to locate the nucleating flaws so that there is a crosscheck with the flaw sizes calculated. In cases where physical-property data were not available, they were measured. Tables give data on hardness, fracture toughness, elastic moduli, and stress wave and fracture velocities.

35194 (AD-A—178136/8/XAB) Organometallic polymers as precursors to ceramic materials: silicon nitride and silicon oxynitride. Technical report. Laine, R.M.; Blum, Y.D.; Hamlin, R.D.; Chow, A. (SRI International, Menlo Park, CA (USA)). 23 Feb 1987. 17p. (TR—5). NTIS, PC A02/MF A01.

A large variety of homogeneous and heterogeneous catalysts were found that will promote the formation of silicon-nitrogen bonds via a dehydrocoupling coupling reaction of Silicon hydrogen bonds with nitrogen-hydrogen bonds. This reaction can be used to synthesize a wide variety of tractable oligo- and polysilazanes. The molecular weight, the viscoelastic properties and the linearity of the polymer can be controlled through proper choice of catalyst and reaction conditions. In addition, the catalyst promotes polymer crosslinking during pyrolysis which leads to high ceramic yields and silicon nitride purities > 95%.

35195 **(BNL—39689) Superconducting properties and microstructures of La/sub 1.85/Sr/sub 0.15/CuO_4 and YBa_2Cu_3O/sub x/.** Suenaga, M.; Ghosh, A.; Asano, T.; Sabatini, R.L.; Moodenbaugh, A.R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-870438—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010047.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

One indication of concern regarding possible uses of these new superconductors in high magnetic fields is the fact that the reporteed values of critical current density J/sub c/ are low, lower than what is required for possible high field applications. In order to investigate the factors which influence the values of J/sub c/ in these oxides, we have measured the magnetization for a number of well-characterized specimens of La/sub 1.85/Sr/sub 0.15/CuO_4 and YBa_2Cu_3O/sub x/ where X~6-7, and preliminary results are summarized.

35196 **(CONF-870862—8) Analytical TEM of grain boundary phases in yttria-zirconia ceramics.** Mecartney, M.L.; Angelini, P. (Minnesota Univ., Minneapolis (USA). Dept. of Chemical Engineering and Materials Science; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010400.

From 45. annual meeting of the Electron Microscopy Society of America; Baltimore, MD, USA (2 Aug 1987).

Yttria-zirconia ceramics have a broad range of applications, from use as structural materials (tetragonal zirconia) to ionic conductors (cubic zirconia). Similar to many ceramic materials, these zirconia ceramics often contain small amounts of amorphous silicate phases at grain boundaries and multiple grain junctions. These phases are a result of impurities, introduced during processing or from the original raw material, or are deliberate additions to aid in the densification via liquid phase sintering. Despite the universality of these grain boundary phases, as of yet little work has been undertaken to understand their effect on the microstructural development, chemistry, and physical properties of the materials. We report here our results on analyzing a series of yttria doped zirconia ceramics to which deliberate additions of various glass phases have been added. The addition of various glass phases has been observed to have profoundly different effects on grain growth and chemical composition of yttria-zirconia ceramics. These effects can be correlated directly with the solubility of the ceramic constituents in the various amorphous phases, as determined by analytical TEM.

35197 **(GRI—86/0195) Manufacturing processes for high-temperature structural ceramics: A patent trend analysis: Topical report.** Levine, L.O. (Pacific Northwest Lab., Richland, WA (USA); Gas Research Inst., Chicago, IL (USA)). Dec 1986. Contract AC06-76RL01830. 106p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010414.

Objective of this study was to characterize the current state of the art in production techniques of high-temperature, structural ceramic materials, and to identify major areas of emphasis in current ceramics research and development efforts. Furthermore, the objective was to relate these findings to future requirements of natural gas technologies where identifiable trends suggest a shifting emphasis in ceramics R & D. Battelle-Northwest used the analysis of patent data to clarify major technical development thrusts and to identify the major companies involved in these efforts. Key patents were identified and a one-day workshop was held as a forum to receive expert input into the evaluation of important patent information.

35198 **(ORNL/Sub—85-43397/01) Alkali attack of coal gasifier refractory linings.** Gentile, M.; Sun, T.; Brown, J.J. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Materials Engineering). Jun 1987. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010967.

The mechanism of alkali and/or alkali-sulfur attack on coal gasifier linings consists of two steps: (1) the release of the alkali and/or alkali-sulfur species from coal, and (2) the reactions with the gasifier lining. The alkali and/or alkali-sulfur species present in the coal gasification atmosphere can be predicted from thermodynamic calculations. The alkali and sulfur compounds formed by the reactions of these species with the refractory cements can also be calculated. Results strongly depend on the accuracy of the thermodynamic data, especially when handling a system of more than 50 species. The alkali and/or alkali-sulfur attack can result in: (1) Incipient melting of the hot face due to alkali fluxing; (2) thermal spalling due to differential thermal expansion of the bulk and the surface compounds; (3) transverse cracking due to internal stresses generated under the surface; and (4) surface washout by dissolution of alkali compounds. When refractories made from the Al_2O_3-SiO_2-CaO system are exposed to alkali atmospheres, alkali reactions appear to be an invevitable consequence from the viewpoint of thermodynamic considerations. Since the total energy of the system will be lowered by the formation of alkali compounds, the compounds formed are usually far less dense than the bulk. The attack can only be retarded by slowing the rate of the reactions. From these results, the recommended methods for retarding alkali attack are: (1) Elevate pressures rather than temperatures in operating conditions; (2) Improve the reactor cooling system; (3) Minimize the refractory porosity; and (4) develop a strong ceramic bond in the refractory. 26 refs.

35199 **(PB—87-167425/XAB) Steam-induced volatilization of silica from refractories. Rept. of Investigations/1986.** Sadler, L.Y.; Davis, E.G. (Bureau of Mines, Tuscaloosa, AL (USA). Tuscaloosa Research Center). 1986. 17p. (BM-RI—9052). NTIS, PC A02/MF A01.

Library of Congress catalog card no. 86-600218.

The Bureau of Mines conducted a study to determine the loss in weight of silica (SiO_2) volatilization from low-alumina Al_2O_3 refractories used as hot face liner materials in such process equipment as coal gasifiers, synthesis gas transfer lines, and ammonia plant secondary reformers. Small specimens of 80- and 40-pct-Al_2O_3 brick and 95-pct-SiO_2 brick were exposed to steam in high-pressure furnaces at pressures of up to 1000 psig and temperatures up to 1400°C for periods ranging up to 120 h. Weight losses from the 40-pct-$A1_2O3$ brick after 40 h of exposure were highest, 2.75% at 1400°C and 1,00 psig. The rate of weight loss had dropped to near zero after 80 h of exposure at all temperatures. No relationship between total silica content of the specimen and weight loss could be established, nor did scanning electron microscopic examination of the specimens before and after exposure identify specific regions (e.g., surface) suffering a disproportionate share of the silica loss. It was concluded that minor silica volatilization is likely to occur, if at all, at temperatures of less than 1000°C and pressures below 1000 psig, and that low-alumina refractories should be used as dry-ash coal gasifier hot-face linings.

35200 **(RISO-M—2622) Fracture toughness measurements on zirconia toughened ceramics.** El Sayed Ali, M.; Toft Soerensen, O. (Risoe National Lab., Roskilde (Denmark)). Dec 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752182.

Three techniques for fracture toughness measurements on zirconia toughened ceramics were evaluated: the notched beam (NB) technique, the indentation fracture (IF) technique and the indentation strength in bending (ISB) technique. Using these techniques comparative measurements were performed on samples prepared by pressing (uniaxial) and sintering of four commercially available powder types. These were: Toya Soda (Japan) powders with the designations TZ3Y (2.86 mole% Y/sub 2/O/sub 3/), TZ3YA (2.77 mole% Y/sub 2/O/sub 3/, 0.1 wt% Al/sub 2/O/sub 3/) and TZ3Y20A (2.88 mole% Y/sub 2/O/sub 3/, 20 wt.% Al/sub 2/O/sub 3/) and a powder supplied by Viking Chemicals (Denmark) designated as YP5Z-2.5 (2.5 mole% Y/sub 2/O/sub 3/). The measurements showed that similar K/sub Ic/ values were obtained with the IF- and ISB-techniques, which therefore are recommended for K/sub Ic/ measurements. Too high values were, however, obtained with the NB-technique which therefore cannot be recommended. Finally, the measurements showed that a high temperature annealing is recommended prior to testing for the IF-technique.

35201 **(SAND—86-2751C) Anomalous Seebeck coefficient in boron carbides.** Aselage, T.L.; Emin, D.; Wood, C.; MacKinnon, I.; Howard, I. (Sandia National Labs., Albuquerque, NM (USA); Jet Propulsion Lab., Pasadena, CA (USA); New Mexico Univ., Albuquerque (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-870438—26). NTIS, PC A02/MF A01; GPO Dep. File Number DE87011287.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Boron carbides exhibit an anomalously large Seebeck coefficient with a temperature coefficient that is characteristic of polaronic hopping between inequivalent sites. The inequivalence in the sites is associated with disorder in the solid. The temperature dependence of the Seebeck coefficient for materials prepared by different techniques provides insight into the nature of the disorder.

35202 **(SAND—86-2804C) Low-carbon boron carbides produced by CVD [chemical vapor deposition].** Campbell, A.N.; Mullendore, A.W.; Tallant, D.R. (Sandia National Labs., Albuquerque, NM (USA); Jet Propulsion Lab., Pasadena, CA (USA)). 1987. Contract AC04-76DP00789. 15p. (CONF-870438—19). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010684.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

Boron carbides with low C contents were produced from BCl_3 and CCl_4 by chemical vapor deposition at temperatures of 1020 to 1500°C. The deposits were found to be between $B_{13}C_2$ and $B_{11}C$ (8.3 to 13.3 at. %C) in composition by means of Auger electron spectroscopy. Raman spectroscopy demonstrates that the specimens contain very little free carbon. Further, disordering of C in the chains and icosahedra of the rhombohedral boron carbide structure for C contents of less than 20 at. % is indicated by the Raman results. Single-phase rhombohedral boron carbides with C contents as low as 12.5 at. % ($\simeq B_7C$) have been produced. The most B-rich specimens, containing 8.3 at. % ($B_{11}C$) or less C, were phase separated. At least one of the phases in the phase separated specimens is tetragonal. The electrical conductivity and Hall mobility of the $B_{11}C$ specimen are reported.

35203 **Orthorhombic-tetragonal phase transition in high-temperature superconductor $YBa_2Cu_3O_7$.** Eatough, M.O.; Ginley, D.S.; Morosin, B.; Venturini, E.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **51**: No. 5, 367-368(3 Aug 1987).

We have determined the effect of elevated temperature on the crystal structure and lattice parameters of the single-phase high-temperature superconductor $YBa_2Cu_3O_7$ using high-temperature x-ray powder diffractometry. This compound is orthorhombic below about 550 °C (depending on oxygen partial pressure) and transforms to a tetragonal polymorph at higher temperatures. The reversibility of this transition depends on the oxygen partial pressure. An oxygen "hopping" mechanism with possible oxygen loss, which appears consistent with the known structural details, is proposed for the transition.

35204 **Superconducting thin films based on La/sub 2-/sub x/Sr/sub x/CuO_4.** de Lima, O.F.; Mattson, J.; Sowers, C.H.; Brodsky, M.B. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **51**: No. 5, 369-370(3 Aug 1987). Contract W-31-109-ENG-38.

Superconducting films (300—400 nm thick) of La/sub 2-/sub x/Sr/sub x/CuO_4 have been prepared by a combined evaporation-reaction method. Amorphous films of the oxide are formed initially on sapphire substrates at deposition temperatures of 25—400 °C. Crystallized films can then be obtained with the desired tetragonal structure and show superconducting resistive transitions, with onsets between 23—28 K and zero resistivities near 4.2 K. A diamagnetic transition consistent with the onset-resistive transition is seen for different samples and a critical current density of 0.4 A/cm^2 is obtained.

35205 **Superconductivity in YBa/sub 2-/sub x/Sr/sub x/Cu_3O/sub 7-/sub δ/.** Veal, B.W.; Kwok, W.K.; Umezawa, A.; Crabtree, G.W.; Jorgensen, J.D.; Downey, J.W.; Nowicki, L.J.; Mitchell, A.W.; Paulikas, A.P.; Sowers, C.H.; and others. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **51**: No. 4, 279-281(27 Jul 1987). Contract W-31-109-ENG-38.

We report structure, resistivity, and Meissner effect measurements on YBa/sub 2-/sub x/Sr/sub x/Cu_3O/sub 7-/sub δ/ for $0<x<2.0$. We find a region of solid solubility extending at least to $x = 1.0$ and a monotonic depression of T/sub c/ with x. Using arguments based on structural changes with Sr doping, we speculate that the depression of T/sub c/ is due to the local distortion of the lattice in the neighborhood of the Sr site and the introduction of additional oxygen vacancies.

35206 **Growth of single-crystal TiN/VN strained-layer superlattices with extremely high mechanical hardness.** Helmersson, U.; Todorova, S.; Barnett, S.A.; Sundgren, J.; Markert, L.C.; Greene, J.E. (Department of Physics, Linkoeping University, S-581 83 Linkoeping, Sweden). *Journal of Applied Physics;* **62**: No. 2, 481-484(15 Jul 1987).

Single-crystal TiN/VN strained-layer superlattices (SLS's) with layer thicknesses l/sub TiN/ = l/sub VN/ = λ/2 (where λ is the period of the superlattice) ranging from 0.75 to 16 nm have been grown on MgO(100) substrates by reactive magnetron sputtering. Cross-sectional transmission electron microscopy (TEM) and x-ray diffraction examinations showed that the films were single crystals exhibiting coherent interfaces and several orders of superlattice reflections. There was no evidence in either plan-view or cross-sectional TEM analyses of misfit interfacial dislocation arrays. The primary defects observed were dislocation loops with a diameter of 8—10 nm extending through several layers and small defects with a diameter of 1—2 nm that were confined within single layers. Microindentation hardness values H, measured as a function of λ in films with a total thickness of 2.5 μm, increased from 2035 +- 280 kg mm^{-2} for Ti/sub 0.5/V/sub 0.5/N alloys (i.e., $\lambda = 0$) to reach a maximum of 5560 +- 1000 kg mm^{-2} at $\lambda = 5.2$ nm and then decreased rapidly to 3950 +- 550 kg mm^{-2} at $\lambda = 7.5$ nm. Further increases in λ resulted in a slower decrease in H to 3640 +- 550 kg mm^{-2} at $\lambda = 32$ nm. The large error bars in the H values for the SLS samples were due to the difficulty in measuring such extremely high hardnesses in thin films.

35207 **Analytical electron microscopic studies and positron lifetime measurements in Al-doped MgO crystals.** Pedrosa, M.A.; Pareja, R.; Gonzalez, R.; Abraham, M.M. (Facultad de Ciencias Fi-breve-acute-accentsicas, Universidad Complutense, 28040 Madrid, Spain). *Journal of Applied Physics;* **62**: No. 2, 429-433(15 Jul 1987).

MgO crystals intentionally doped with Al were characterized by analytical electron microscopic examinations and positron lifetime measurements. Large spinel (MgO Al_2O_3) precipitates were observed in samples with high contents of Al. A well-defined crystallographic relationship between the precipitates and the matrix was found. The characteristics of positron lifetime spectra appear to depend on the valence state of the different impurities in the MgO lattice suggesting that positrons are trapped by vacancy impurity complexes.

35208 **Structure of the single-phase high-temperature superconductor YBa_2Cu_3O/sub 7-/sub δ/.** Beno, M.A.; Soderholm, L.; Capone, D.W. II; Hinks, D.G.; Jorgensen, J.D.; Grace, J.D.; Schuller, I.K.; Segre, C.U.; Zhang, K. (Argonne National Laboratory, Argonne, Illinois 60439). *Applied Physics Letters;* **51**: No. 1, 57-59(6 Jul 1987). Contract W-31-109-ENG-38.

We have determined the crystal structure of the single-phase stoichiometric high-temperature superconductor in the Y-Ba-Cu-O system using high-resolution neutron powder diffraction. This compound has an orthorhombic structure with space group Pmmm and lattice constants a = 3.8231 A, b = 3.8864 A, and c = 11.6807 A. The structure consists of "dimpled" CuO_2 layers in the a-b planes

loosely bonded by one-dimensional fencelike square-planar CuO_3 chains in the b-c planes.

35209 **Magnetization and susceptibility studies of the superconductive compound $Gd_1Ba_2Cu_3O$/sub z/.** Thompson, J.R.; Sekula, S.T.; Christen, D.K.; Sales, B.C.; Boatner, L.A.; Kim, Y.C. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831-6061). *Physical Review [Section] B: Condensed Matter;* **36**: No. 1, 718-721(1 Jul 1987).

The magnetic susceptibility and magnetization of the superconductive compound $Gd_1Ba_2Cu_3O$/sub z/ has been studied in the temperature range from 1.5 to 270 K. The magnetic susceptibility chi of the material, which has a superconductive transition temperature T/sub c/ near 95 K, follows a Curie-Weiss law both above and below T/sub c/ with the full Gd magnetic moment, p/sub eff/ = 7.84μ/sub B/, being observed. The independence of the superconductive and magnetic behavior indicates that superconductivity in this system is highly anisotropic. This conclusion is supported by magnetization measurements below T/sub c/, which also yield an antiferromagnetic, Curie-Weiss-like temperature FTHETA/sub M/ of +2.3 K.

35210 **Superconducting shells in ceramic $YBa_2Cu_3O_7$.** Ginley, D.S.; Venturini, E.L.; Kwak, J.F.; Baughman, R.J.; Morosin, B.; Schirber, J.E. (Sandia National Laboratories, P.O. Box 5800, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **36**: No. 1, 829-832(1 Jul 1987). Contract AC04-76DP00789.

We demonstrate that, even in single-phase ceramic $YBa_2Cu_3O_7$, superconductivity occurs in only thin shells surrounding normal grains. The shells comprise no more than 25 vol% of the material, independent of preparation technique and subsequent processing. This conclusion is based on comparison of magnetic flux exclusion, Meissner and resistivity data for bulk, compacted, and ground materials. We show that these data depend on the sample microstructure, but do not arise from pinning effects.

35211 **Electronically driven reconstruction of TaC(100).** Noonan, J.R.; Davis, H.L.; Gruzalski, G.R. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 787-789(Jul 1987). Contract AC05-84OR21400.

The structure of a stoichiometric TaC(100) surface has been determined by an analysis of its low-energy electron diffraction I—V spectra. It was determined that the surface is reconstructed such that <011> rows of carbon atoms are displaced outward and <011> rows of Ta inward with respect to the truncated bulk atomic layer. The electrostatic forces on the surface atoms that are induced by the termination of the solid drive this rippled reconstruction.

35212 **Detailed characterization of TiC and TiN coatings prepared by the activated reactive evaporation process.** Lin, P.; Deshpandey, C.; Doerr, H.J.; Bunshah, R.F.; Kaufherr, N.; Nielsen, R.; Fenske, G. (University of California, Los Angeles, California 90024). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2732-2736(Jul 1987).

The objective is to investigate the relationship between the composition, microstructure, and microhardness of TiC and TiN coatings prepared over a range of process parameters using the activated reactive evaporation process. The composition was measured by Auger electron spectroscopy. The phase relationships and preferred orientation were obtained by x-ray diffraction analysis. Microhardness and adhesion of the coatings were measured. The results show that the microhardness depends on the composition/stoichiometry, phases present, the preferred orientation, and possibly the grain size in the case of single-phase coatings.

35213 **Theory of high-T/sub c/ superconductivity in oxides.** Emery, V.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **58**: No. 26, 2794-2797(29 Jun 1987). Contract AC02-76CH00016.

It is shown that the properties of high-T/sub c/ oxide superconductors are consistent with a model in which the charge carriers are holes in the O(2p) states and the pairing is mediated by strong coupling to local spin configurations on the Cu sites.

35214 **Experimental evidence for granular superconductivity in Y-Ba-Cu-O at 100 to 160 K.** Cai, X.; Joynt, R.; Larbalestier, D.C. (Applied Superconductivity Center, University of WisconsinMadison, Madison, Wisconsin 53706;). *Physical Review Letters;* **58**: No. 26, 2798-2801(29 Jun 1987).

We have observed anomalous voltage excursions as a function of temperature and magnetic field in samples of Y-Ba-Cu-O above 100 K. These transient voltages are attributed to flux jumps which are characteristic of granular superconductors. The field dependence of the effect strongly supports this interpretation. We conclude that there exists grains in the sample with superconducting transition temperatures at least as high as 160 K.

35215 **Antiferromagnetism in La_2CuO/sub 4-//sub y/.** Vaknin, D.; Sinha, S.K.; Moncton, D.E.; Johnston, D.C.; Newsam, J.M.; Safinya, C.R.; King H.E. Jr. (Corporate Research Laboratories, Exxon Research and Engineering Company, Annandale, New Jersey 08801). *Physical Review Letters;* **58**: No. 26, 2802-2805(29 Jun 1987).

Powder neutron diffraction studies of undoped La_2CuO/sub 4-//sub y/ have revealed new superlattice peaks below —220 K. The absence of corresponding x-ray superlattice lines and an observed susceptibility anomaly near 220 K suggest the occurrence of antiferromagnetism. From the magnetic peak intensities we deduce a structure consisting of ferromagnetic sheets of Cu spins alternating along the [100] orthorhombic axis, with the spins aligned along the [001] orthorhombic axis, The low-temperature magnetic moment is approximately 0.5μ/sub B//(Cu atom). The tetragonal-orthorhombic transition at 505 K has also been studied.

35216 **Lanthanum hexaboride (LaB_6) resistivity measurement.** Williams, M.D.; Jackson, L.T.; Kippenhan, D.O.; Leung, K.N.; West, M.K.; Crawford, C.K. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **50**: No. 25, 1844-1845(22 Jun 1987). Contract W-7405-ENG-48;AC03-76SF00098.

In the development of high-power free-electron lasers, intense electron beams are required. Large area, directly heated lanthanum hexaboride cathodes have been proposed as the electron emitter. To aid in the design of the cathode, the resistivity of lanthanum hexaboride as a function of material density and temperature has been measured.

35217 **Bipolarons in boron-rich icosahedra: Effects of carbon substitution.** Howard, I.A.; Beckel, C.L.; Emin, D. (Department of Physics and Astronomy, University of New Mexico, Albuquerque, New Mexico 87131). *Physical Review [Section] B: Condensed Matter;* **35**: No. 17, 9265-9270(15 Jun 1987).

Analysis of electronic-transport and magnetic measurements on boron carbides has indicated that charge transport occurs via bipolaron hopping between the twelve-atom icosahedral structural units of these solids. Two types of isoelectronic icosahedral units are neutral icosahedral boron clusters (B/sub 12/ icosahedra) and positively charged clusters of eleven boron atoms and a carbon atom [$(B_{11}C)^+$ icosahedra]. In particular, the transport analysis assumes that it is energetically favorable for an electron pair to occupy a $(B_{11}C)^+$ icosahedron rather than a B/sub 12/ icosahedron. Here, we study the energy changes and atomic displacements associated with adding two electrons to a $(B_{11}C)^+$ icosahedron in neutral surroundings and compare our results with our previous study of two electrons added to an analogous B/sub 12/ icosahedron. We find that the addition of the two electrons reduces the $(B_{11}C)^+$ system's energy by about 18 eV.

35218 Comparison of the critical magnetic scattering from the Heisenberg system EuO with renormalization-group theory. Boeni, P.; Chen, M.E.; Shirane, G. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8449-8453(1 Jun 1987). Contract AC02-76CH00016.

The paramagnetic scattering from the isotropic Heisenberg ferromagnet EuO has been investigated by inelastic neutron scattering in order to test the predictions of asymptotic renormalization-group theory. The scattering cross sections are in excellent agreement with theory over a wide range of momentum and energy ($q<0.3$ A/sup -1/, $\omega<0.4$ meV).

35219 Pressure dependence of the superconducting transition temperature in the 94-K superconductor $YBa_2Cu_3O_7$. Schirber, J.E.; Ginley, D.S.; Venturini, E.L.; Morosin, B. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8709-8710(1 Jun 1987). Contract AC04-76DP00789.

We present the pressure dependence of the superconducting transition temperature for a variation of preparations of the 94-K superconductor Y-Ba-Cu-O. All preparations show a superconducting transition temperature near 90 K and a small positive derivative dT/sub c//dP = 0.07 +- 0.02 K/kbar.

35220 Tunneling spectroscopy of a La-Sr-Cu-O break junction: Evidence for strong-coupling superconductivity. Moreland, J.; Clark, A.F.; Goodrich, L.F.; Ku, H.C.; Shelton, R.N. (National Bureau of Standards, Electromagnetic Technology Division, Boulder, Colorado 80303). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8711-8713(1 Jun 1987).

Detailed structure in the quasiparticle tunneling has been observed in La-Sr-Cu-O superconductive tunneling junctions using the break-junction technique. Variability in the energy gap and associated structure in the current-voltage curves is observed indicating significant inhomogeneity in the superconducting properties. Large energy gaps (7.0 meV) and deep structure in the conductance derivatives are evidence for a strong-coupling mechanism.

35221 Elasticity studies of La/sub 2-//sub x/Sr/sub x/CuO_4. Bourne, L.C.; Zettl, A.; Chang, K.J.; Cohen, M.L.; Stacy, A.M.; Ham, W.K. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8785-8787(1 Jun 1987).

We report measurements of Young's modulus Y and internal friction δ of the high-T/sub c/ superconductor La/sub 2-//sub x/Sr/sub x/CuO_4. For $x = 0.15$, anomalies in Y and δ at T/sub c/ = 40 K are preceded by a dramatic decrease in Y, indicative of a soft phonon mode beginning near 200 K. For $x = 0.30$, the softening is absent. The magnetic field dependence of Y and δ is investigated, and predictions are made for ΔC/sub p/ and partialH/sub c/$_2$/partialT.

35222 Transport properties of the superconducting oxide La/sub 1.85/Sr/sub 0.15/CuO_4. Hundley, M.F.; Zettl, A.; Stacy, A.; Cohen, M.L. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8800-8803(1 Jun 1987).

We report electrical-resistivity, Hall-effect, and thermoelectric-power (TEP) measurements on the superconducting oxide La/sub 1.85/Sr/sub 0.15/CuO_4. The transport properties indicate that in the normal state the material conducts via holes with a carrier concentration of 6.0 x 10/sup 21/ cm/sup -3/. Evidence is observed for unusual phonon-drag effects above the superconducting transition temperature T/sub c/ and granular or inhomogeneous superconductivity in the vicinity of T/sub c/. Below T/sub c/ the resistivity, Hall constant, and TEP all drop to zero, as expected for a superconducting ground state.

35223 Photoemission studies of the high-T/sub c/ superconductor Ba_2YCu_3O/sub 9-//sub δ/. Johnson, P.D.; Qiu, S.L.; Jiang, L.; Ruckman, M.W.; Strongin, M.; Hulbert, S.L.; Garrett, R.F.; Sinkovic, B.; Smith, N.V.; Cava, R.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8811-8813(1 Jun 1987).

Valence-band photoemission measurements have been made both above and below the T/sub c/ of Ba_2YaCu_3O/sub 9-//sub δ/ where $\delta = 2.1$. We find similarities to recent calculations of the electronic properties. However, the experimental binding energies are between 1.0 and 1.4 eV further from the Fermi level than the calculation. We suggest that this difference may affect attempts to predict T/sub c/ from tight-binding modeling of the electron-phonon mechanism.

35224 Phonon density of states in La/sub 1.85/Sr/sub 0.15/CuO_4. Ramirez, A.P.; Batlogg, B.; Aeppli, G.; Cava, R.J.; Rietman, E.; Goldman, A.; Shirane, G. (AT & T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8833-8836(1 Jun 1987).

Specific-heat and inelastic neutron scattering studies of the high-T/sub c/ superconducting compound La/sub 1.85/Sr/sub 0.15/CuO_4 are reported. A distinct anomaly of electronic origin in the specific heat is found at the superconducting transition temperature. The phonon density of states up to —20 meV is extracted from both experiments and the two sets of results agree well in yielding a sharply enhanced density of states at 10 meV, in accord with a recent theoretical study.

35225 Phonon dispersion curves for La/sub 1.85/Sr/sub 0.15/CuO_4. Brun, T.; Grimsditch, M.; Gray, K.E.; Bhadra, R.; Maroni, V.; Loong, C. (Materials Science Division, Argonne National Laboratory, Argonne Illinois 60439). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8837-8839(1 Jun 1987).

Using a simple mechanical model we have calculated the bare phonon dispersion curves for $(La,Sr)_2CuO_4$. Fitting the frequencies of the four Raman modes and one infrared (IR) mode, our calculation reproduces the position of the other IR modes for which experimental evidence exists as well as the shear-wave velocity. This calculation yields information on the phonons which may be important for an understanding of the superconductivity.

35226 Tunneling measurement of the energy gap in Y-Ba-Cu-O. Crommie, M.F.; Bourne, L.C.; Zettl, A.; Cohen, M.L.; Stacy, A. (Department of Physics, University of California, Berkeley, California 94720). *Physical Review [Section] B: Condensed Matter;* **35**: No. 16, 8853-8855(1 Jun 1987).

Superconductor-insulator-normal tunneling measurements have been performed on the high-T/sub c/ superconductor YBa_2Cu_3O/sub 9-//sub δ/ at 4.2 and 77 K. The results indicate an energy gap of magnitude $2\Delta_0$/k/sub B/T/sub c/$\approx$3.9 at T = 0, with a temperature dependence consistent with the Bardeen-Cooper-Schrieffer theory of superconductivity.

35227 Deposition method for producing silicon carbide high-temperature semiconductors. Hsu, G.C.; Rohatgi, N.K. (to Dept. of Energy, Washington, DC). US Patent 4,664,944. 12 May 1987. Filed date 31 Jan 1986. vp.

A deposition method is described for producing silicon carbide high-temperature semiconductors. The method comprises placing at least one semiconductor substrate composed of silicon carbide in a fluidized bed silicon carbide deposition reactor comprising bed particles. The fluidized bed comprises SiC, Si particles or mixtures thereof; introducing reactants selected from CH/sub 3/SiCl/sub 3/ or a SiH/sub 4/ /C/sub 3/H/sub 8/ mixture into the reactor; fluidizing by hydrogen gas in a mildly bubbling mode through a gas distributor at the bottom of the reactor; and heating the substrate at temperatures around 1200°-1500°C thereby causing deposition of a layer of silicon carbide on the semiconductor substrate. A deposition method wherein at least one substrate is heated at a deposition temperature, while the bed particles are unheated is also given.

35228 Effects of pH and temperature on sol-gel processing within the PbO-TiO/sub 2/ system. Lee, M.H.; Park, Y.H.; Yang, C.K. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA 16802). *Journal of the American Ceramic Society;* 70: No. 2, C35-C37(Feb 1987).

Effects of sol formation temperature and pH value on sol-gel processing within the PbO-TiO/sub 2/ system were investigated. PbO-TiO/sub 2/gels were prepared from the mixed solution of lead nitrate and titanium tetrachloride at 30° to 70°C under various pH values of 1.0 to 10.8, and dehydrated at 60° to 80°C for 72 h under vacuum. The dried gels are amorphous. The crystalline phases of the products after calcination at 720°C for 1 h in air are dependent upon the sol formation conditions.

35229 Dielectric and ferroelectric properties of ceramics in the Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3/-BaTiO/sub 3/-PbTiO/sub 3/ system. Halliyal, A.; Kumar, U.; Newnham, R.E.; Cross, L.E. (Materials Research Lab., The Pennsylvania State Univ., University Park, PA). *Journal of the American Ceramic Society;* 70: No. 2, 119(Feb 1987).

The use of Pb(Zn/sub 1/3/Nb/sub 2/3/)O/sub 3/ ceramics is restricted by the formation of a pyrochlore phase detrimental to both dielectric and piezoelectric properties. Recently, it has been shown that a 6 mol% addition of BaTiO/sub 3/ to PZN suppresses the formation of pyrochlore phase. Phase relations and dielectric properties of ceramics in the PZN-BT-PT system are reported in this paper.

3606 Other Materials

REFER ALSO TO CITATION(S) 34570, 34751, 34757, 34757, 34758, 34776, 34970, 35033, 35120, 35194, 35318, 35321, 35323, 35324, 35374, 35381, 35382, 35414, 35415, 35416, 35419, 35420, 35421, 35423, 35423, 35526, 35535, 35939, 36089, 36091, 36093, 36168

35230 (AD-A—178262/2/XAB) Characterization of material device structures. Final report, January 1984-September 1986. Look, D.C.; Yu, P.W.; Norris, G.E.; Walters, D.C.; Theis, W.M. (Wright State Univ., Dayton, OH (USA). Univ. Research Center). 11 Feb 1987. 82p. NTIS, PC A05/MF A01.

Impurities and defects in semiconducting and semi-insulating GaAs and other III-V compounds were investigated by electrical, optical, and mass-spectroscopic techniques. Modulation-doped field-effect transistors were fabricated and tested. A CAE/CAD environment was implemented for the design, development, and evaluation of electronic circuitry.

35231 (AD-A—178277/0/XAB) Chemical bonding topology of superconductors. 1. Ternary molybdenum chalcogenides (Chevrel phases). Technical report. King, R.B. (Georgia Univ., Athens (USA). Dept. of Chemistry). 6 Mar 1987. 25p. NTIS, PC A02/MF A01.

See also AD—A178-079.

Models for the chemical-bonding topologies of ternary molybdenum chalcogenides (Chevrel phases) are derived using methods based on graph theory. The molybdenum sulfite Chevrel phases as well as their selenium analogues are viewed as three-dimensional lattices of edge-localized discrete molybdenum octahedra link octahedra through face-sharing leads successively to the Mo_8S_{11} napthalene analogue and the $Mo_{12}S_{14}$ anathracene analogue with increasing fusion leading to increasing delocalization of the chemical bonding topology within individual molybdenum cluster units. The infinite limit of such fusion of molybdenum octahedra corresponds to the infinite-chain pseudo-one-dimensional metals formulated with globally delocalized octahedral cavities.

35232 (AD-A—178808/2/XAB) Effect of processing parameters on the tensile properties of alumina-fiber-reinforced magnesium. McMinn, A.; Page, R.A.; Wei, W. (Southwest Research Inst., San Antonio, TX (USA)). Feb 1987. 11p. NTIS, PC A02/MF A01.

Pub. in Metallurgical Transactions A, Vol. 18A, 273-281(Feb 1987).

The effect of processing variables on the tensile properties of commercially pure (CP) magnesium reinforced with FP alumina fibers studied. Composite plates were cast at 698, 755, and 810 C, with a five-minute hold period prior to solidification. The properties of the composites were compared to those of both conventionally cast CP magnesium and ZE41A (Mg-4.2Zn-0.5Zr-1.25RE) composites. The tensile properties were found to be independent of casting temperature in the range 698 to 810 C, although the five-minute hold period significantly decreased the axial properties of the CP magnesium. The results indicated that, during processing, the time at temperature has a more-pronounced effect on tensile strength than the actual casting temperature. Increasing casting temperature was found to increase th MgO fiber-matrix reaction zone to a size comparable to that observed in conventionally processed ZE41A material. However, the strengths of the CP magnesium composites cast at the three different temperatures were significantly lower than that of ZE41A, indicating that the interfacial strengthening observed in ZE41A is not due to larger MgO reaction-zone particles. A possible explanation for the interfacial strengthening in ZE41A is the presence of zinc and aluminum in low concentrations, which act to enhance the bonding between the reaction zone and the metallic matrix.

35233 (DOE/ER/13183—1) Studies of acid states formed by doping cations onto oxide surfaces: Final report. Dumesic, J.A. (Wisconsin Univ., Madison (USA)). Jun 1987. Contract FG02-84ER13183. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010861.

We have used quantitative gravimetric, calorimetric and spectroscopic methods to determine the number, type and strength of acid sites on metal oxides. The methods will allow future studies of quantitative relationships between surface acidity and catalytic properties of metal oxides, thereby allowing researchers to understand and prepare new catalytic materials. In our particular studies, we have determined the factors that are responsible for determining the strength of Lewis acid sites generated by depositing various metal oxides onto silica. In addition, we have identified a number of factors responsible for the generation of Bronsted acid sites on silica. From our catalytic studies of isopropanol dehydration, the catalytic activity is not simply related to the Lewis acid strength. Instead, Bronsted acid sites are more effective for this reaction than Lewis acid sites. We are currently using microcalorimetric measurements to understand further the quantitative aspects of acidity for our chosen catalytic probe reaction.

35234 (DOE/ER/45103—T1) Physical and optical properties of chromium-doped glass-ceramics. Beall, G.H.; Cole, D.R.; Hall, D.W.; Holland, H.J.; Schreurs, J.W.H.; Edwards, M.; Gilles, R.; Lempicki, A. (Corning Glass Works, NY (USA). Research and Development Div.; Boston Univ., MA (USA). Dept. of Chemistry). [1987]. Contract FG02-84ER45103. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010584.

The physical and optical properties of glass-ceramics containing transition metal ions are reported. Work centers on the mullite glass-ceramic family with chromium as the active center, although other hosts and dopants are considered. Crystallite structure, absorption spectra, and luminescent properties are examined for a wide range of precursor glass compositions. Detailed measurements of crystallite morphology and structure, absolute quantum efficiency, and scattering coefficients are made for two promising compositions as a function of heat treatment. For a specific heat treatment, one composition has a wavelength average quantum efficiency of 31% and a scattering coefficient at the wavelength of maximum luminescence emission of 0.04 cm^{-1}. Results of experiments to determine details of the microscopic environment of Cr in mullite glass-ceramics are presented. A computational analysis of the performance of luminescent solar concentrators based on mullite glass-ceramics is described, as are experiments using large pieces of the material which verify the validity of the analysis.

35235 (DOE/ER/45165—T1) Ultrasonic studies of dislocation dynamics in LiF: Final report. Han, M.; Hikata, A.; Elbaum, C. (Brown Univ., Providence, RI (USA). Metals Research Lab.). 1985. Contract FG02-84ER45165. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87011012.

This thesis is about an experimental study of dislocation dynamics of LiF single crystals using ultrasonic techniques combined with dynamic loading. Time evolution of the deformation process under a short time stress pulse at a fixed temperature, and the temperature dependence of the dislocation damping mechanism were the main questions of concern.

35236 **(DOE/PC/70808—T1) Novel materials for base catalysis: Quarterly progress report, January-March 1987.** Marcelin, G. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-84PC70808. 10p. NTIS, PC A02/MF A01. File Number DE87010860.

The effect of hydrothermal treatment is currently being investigated by studying the changes in thermal and sorptive characteristics. Hydrothermal treatment has been found to affect the crystallite size, the character of the interlayer anion and its thermal stability.

35237 **(LBL—20457) A finite element analysis of the seeding process for crystal growth by the Horizontal Bridgeman method.** Smidebush, M. (Lawrence Berkeley Lab., CA (USA)). Sep 1985. Contract AC03-76SF00098. 103p. NTIS, PC A06. File Number DE87011222.

A Front Tracking finite element code was used to study movements of the solid-liquid interface which occur during the seeding process of semiconductor crystal growth. The analysis focused on improving control of the interface through use of seed crystal "blankets." Thermal properties of the blanket materials ranged from isotropic to strongly anisotropic. Results showed that a seed blanket can be effective in control of both the interface position and shape during the seeding process.

35238 **(LBL—23488) General description of a semiconductor superlattice.** Krushwitz, K. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011214.

A qualitative description of the physics of a semiconductor superlattice is presented in relation to chemistry. A section of this paper is devoted to semiconductor superlattice construction to underscore the salient characteristics of electrical conductivity, photoluminescence and optical enhancement for elements in Groups III-VI of the periodic table.

35239 **(SAND—87-1341C) Mechanisms of silicon CVD [chemical vapor deposition].** Ho, P.; Breiland, W.G.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 10p. (CONF-870760—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010474.

From 8. international symposium on organosilicon chemistry; St. Louis, MO, USA (7 Jul 1987).

The microelectronics and solar-cell industries rely heavily on silicon thin films. Such films are generally produced via chemical vapor deposition (CVD) from silanes or chlorosilanes. We describe a coordinated program of experimental and theoretical research into the fundamental mechanisms of CVD. The experimental program uses laser spectroscopic techniques for in situ measurements during CVD. The theoretical program consists of a computer model that contains a detailed description of the coupled fluid mechanics and gas-phase chemical kinetics in silane CVD.

35240 **(SAND—87-1465C) Environmentally-controlled fracture.** Michalske, T.A.; Bunker, B.C.; Tallant, D. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8706123—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010954.

From Topical symposium on recent developments in ceramic science; Albuquerque, NM, USA (17 Jun 1987).

Theoretical and experimental studies of oxide surface reactivity were combined to develop quantitative atomistic models for reactions which promote stress corrosion crack growth. These models address three basic processes influencing the structural reliability of ceramic materials: effects of mechanical strain and chemical environment on the kinetics of the crack tip bond rupture process, effect of surface reaction products on the structure and stress state at the crack tip, and chemical bonding mechanisms which can be used to heal fracture surfaces together. Silica glass was used in the studies.

35241 **(UCRL—95427) Nucleation and growth of silicon microstructures by direct-laser writing.** Kotecki, D.E.; Herman, I.P. (Lawrence Livermore National Lab., CA (USA); Columbia Univ., New York (USA). Dept. of Applied Physics). 1986. Contract W-7405-ENG-48. 10p. (CONF-861207—108). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010274.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

This paper reports a study of the nucleation phase of thin film growth during pyrolytic deposition by direct-laser writing. A Monte Carlo computer simulation is used to model the initial surface dynamics occurring during the deposition of silicon from silane (SiH_4) on strongly binding substrates such as silicon, and on weakly binding substrates such as silicon dioxide (SiO_2) and silicon nitride (Si_3N_4). Results show that for high peak temperatures and weakly binding substrates, the most probable location for the initiation of thin film growth is displaced from the center of the locally laser heated region of the surface. At low peak temperatures, thin film nucleation is found to begin at the center of the locally laser-heated surface for all substrates.

35242 **Hydrogen motion in thermally annealed sputter-deposited hydrogenated amorphous silicon.** Bevolo, A.J.; Albers, M.L.; Shanks, H.R.; Shinar, J. (Ames Laboratory, United States Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **62**: No. 4, 1240-1244(15 Aug 1987). Contract W-7405-ENG-82.

It is shown that the bulk hydrogen concentration in radio-frequency (rf) sputtered films of hydrogenated amorphous silicon (a-Si:H) can be determined from reflected electron energy-loss spectroscopy signals obtained even during ion beam etching of the film. As a result, depth profiling, with a 50-A depth resolution of the hydrogen concentration, and with 1 at. % accuracy of the a-Si:H/sub x//a-Si:H/sub y/ multilayer, is achieved. Using this technique to depth profile annealed multilayer samples of rf sputter-deposited a-Si:H, it was found that despite the loss of hydrogen at elevated temperatures the original interface widths are unchanged even after a 500 °C, 1 h anneal. This result contrasts sharply with previous measurements of hydrogen motion in glow-discharge a-Si:H and indicates a significant difference between the two types of a-Si:H with respect to hydrogen motion at elevated temperatures.

35243 **Surface properties of Cr_2O_3.** Kirby, R.E.; Garwin, E.L.; King, F.K.; Nyaiesh, A.R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* **62**: No. 4, 1400-1405(15 Aug 1987). Contract AC03-76SF00515.

Thin (<5 nm) air-oxidized Cr layers are deposited on the alumina output windows of radio-frequency klystron tubes to prevent electron multipactor by reducing the secondary electron emission yield of the alumina surface. The top several nanometers of these layers appear to be Cr_2O_3. To compare the measured surface properties of these layers with those of clean stoichiometric Cr_2O_3, quasibulk Cr_2O_3 layers were produced by wet-H_2-firing magnetron-deposited Cr films on Cu substrates and characterized by x-ray photoelectron-, Auger electron-, and electron energy loss spectra and secondary electron emission yield measurements. Other properties measured were x-ray diffraction structure, sheet resistance, and optical reflectivity. In particular, the peak of the secondary electron yield was found to be —1.7, which is considerably higher than the <1 yield value reported earlier in the literature. The Cr_2O_3 Cr 2p x-ray photoelectron core level spectrum was curve-fit using Doniach—Sunjic line shapes and statistical fitting methods. It is shown that each 2p level is composed of three multiplet-split peaks 1.1 eV apart. In addition, the three $2p_1$/sub //$_2$ peaks are folded with a $2p_3$/sub //$_2$ 3d satellite.

35244 Kinetics and oxide composition for thermal oxidation of cadmium telluride. Wang, F.; Schwartzman, A.; Fahrenbruch, A.L.; Sinclair, R.; Bube, R.H.; Stahle, C.M. (Department of Materials Science and Engineering, Stanford University, Stanford, California 94305). *Journal of Applied Physics;* **62**: No. 4, 1469-1476(15 Aug 1987).

Thermal oxidation of single-crystal p-type CdTe has been carried out in dry and wet oxygen. The thickness of the oxide varies as the square root of oxidation time, implying a diffusion controlled process. The activation energy for thermal oxidation is 1.2 eV. Examination of the oxide by Auger electron spectroscopy, x-ray photoelectron spectroscopy, and transmission electron microscopy shows that the composition of thick layers is $CdTeO_3$; thin layers less than 100 A thick may differ slightly in composition. An oxygen gradient is detected in as-grown thin oxides, but with storage in air at room temperature the oxygen gradient disappears. Values of chemical shift of the x-ray photoelectron spectroscopy peaks for the cadmium-tellurium-oxygen ternary system are clarified.

35245 Measurements of the optical properties of liquid silicon and germanium using nanosecond time-resolved ellipsometry. Jellison G.E. Jr.; Lowndes, D.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Applied Physics Letters;* **51**: No. 5, 352-354(3 Aug 1987). Contract AC05-84OR21400.

The optical properties of liquid silicon and germanium have been determined at several laser wavelengths from 1.96 to 3.71 eV, using time-resolved ellipsometric measurements during pulsed laser melting. The results from these transient melting experiments are compared with results from the literature for materials held above their melting temperatures for long periods of time. The results for liquid germanium agree well with those of J. N. Hodgson [Philos. Mag. 6, 509 (1961)], but the results for liquid silicon disagree with the results of K. M. Shvarev, B. A. Baum, and P. V. Gel'd [High Temp. 15, 548 (1977)].

35246 Lattice relaxation of pressure-induced deep centers in GaAs:Si. Li, M.F.; Yu, P.Y.; Weber, E.R.; Hansen, W. (Department of Physics, University of California, Berkeley and Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **51**: No. 5, 349-351(3 Aug 1987). Contract AC03-76SF00098.

Deep centers induced by hydrostatic pressure in GaAs:Si have been studied by deep level transient spectroscopy and constant temperature capacitance transient techniques. The capture behavior of these centers has been studied in detail and found to be consistent with the multiphonon emission theory. The pressure coefficients of the ionization energy and the barrier height are consistent with the large lattice relaxation model proposed by D. V. Lang and R. A. Logan [Phys. Rev. Lett. 39, 635 (1977)].

35247 Equilibrium theory of polymer liquids: Linear chains. Curro, J.G.; Schweizer, K.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **87**: No. 3, 1842-1846(1 Aug 1987). Contract AC04-76DP00789.

An equilibrium theory of polymer melts, developed previously by us for polymer rings, is generalized to include linear polymer chains. This theory is based on the reference interaction site model (RISM) integral equation approach developed by Chandler and co-workers for molecular liquids. We are able to construct a tractable formalism for the high polymer problem by employing the fact that a polymer molecule in a melt is ideal. This leads to a set of coupled, nonlinear integral equations for the intermolecular radial distribution functions. A simple optimized perturbative scheme is developed for long linear chains based on the relative unimportance of end effects. To lowest order, the theory reduces to a single nonlinear integral equation. Chain end corrections to the site-averaged intermolecular correlation functions vanish according to N^{-2}, where N is the degree of polymerization. Numerical techniques were used to compute the radial distribution function and structure factor for hard core linear Gaussian chains of 16 000 units over a range of densities. Calculation of higher order corrections for end effects is possible with our formalism.

35248 IR, optical, and electron-spin-resonance study of as-deposited and annealed a-Ge/sub 1-//sub x/C/sub x/:H prepared by rf sputtering in $Ar/H_2/C_3H_8$. Shinar, J.; Wu, H.S.; Shinar, R.; Shanks, H.R. (Ames Laboratory: U.S. Department of Energy and Department of Physics, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **62**: No. 3, 808-812(1 Aug 1987). Contract W-7405-ENG-82.

Hydrogenated amorphous germanium carbide (a-Ge/sub 1-//sub x/C/sub x/:H) films were prepared by rf sputtering, at various rf power levels and mixtures of Ar, H_2, and propane. As in the case of a-Si:H rf sputtered under similar conditions, the concentration of Ge—H bond, as determined by the IR absorption spectra, and the Tauc determined optical gap, generally increase as the rf power is decreased. The optical gap of the a-Ge/sub 1-//sub x/C/sub x/:H films range from 0.85—2.3 eV, and the electron-spin-resonance defect spin densities from 6.5×10^{17} to 3×10^{18} spins/cm^3. Auger spectroscopy was used to determine the C/Ge ratio and indicated that in most of the samples, this ratio was approx. <0.15. Isochronal annealing up to 400 °C indicated that (i) Ge-C segregation effects already initiated at 100 °C are greatly enhanced above 300 °C, (ii) at 300 °C C—H bonds are formed at the expense of Ge—H ones, and (iii) all of the hydrogen bonded to Ge and most of that bonded to carbon evolve out of the sample at or slightly below 400 °C.

35249 High-temperature heat contents, thermal diffusivities, densities, and thermal conductivities of n-type SiGe(GaP), p-type SiGe(GaP), and p-type SiGe alloys. Amano, T.; Beaudry, B.J.; Gschneidner K.A. Jr.; Hartman, R.; Vining, C.B.; Alexander, C.A. (Ames Laboratory and Department of Materials Science and Engineering, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* **62**: No. 3, 819-823(1 Aug 1987). Contract W-7405-ENG-82.

The high-temperature heat contents of n-type SiGe(GaP), p-type SiGe(GaP), and p-type SiGe alloys were measured from 400 to 1400 K by using a copper block drop calorimeter. The heat capacity and related thermodynamic functions were calculated. Smoothed values of H°/sub T/-H°/sub 298.15/, C/sub p/, S°/sub T/-S°/sub 298.15/, and -(F°/sub T/-H°/sub 298.15/)T^{-1} were tabulated at 100-K intervals. Thermal diffusivities were measured by using a laser technique. Thermal conductivities were calculated from the heat capacity, thermal diffusivity, and density.

35250 Third harmonic generation from a monolayer film of a polydiacetylene, poly-4-BCMU. Berkovic, G.; Shen, Y.R.; Prasad, P.N. (Department of Physics, University of California, Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 3, 1897-1898(1 Aug 1987). Contract AC03-76SF00098.

Third harmonic generation has been observed for the first time from a monolayer film on water subphase. This study, conducted for a polydiacetylene, poly-4-BCMU, reveals a conformational transition in the monolayer film whereby the effective π-electron conjugation is reduced. From the study, the orientation of the polymer at the water subphase and the value of the second hyperpolarizability γ along the polymer chain is also determined. The corresponding bulk susceptibility chi/sup (/^{3}/sup)/ is found to be in agreement with those reported by earlier studies.

35251 Raman study of an epitaxial GaAs layer on a Si [100] substrate. Huang, Y.; Yu, P.Y.; Charasse, M.; Lo, Y.; Wang, S. (Department of Physics, University of California and Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Applied Physics Letters;* **51**: No. 3, 192-194(20 Jul 1987). Contract AC03-76SF00098.

A bevel has been etched in a GaAs epitaxial film grown on a Si substrate, so that the Raman spectrum of the GaAs layers can be measured as a function of distance from the GaAs/Si interface. The amount of strain and disorder in the GaAs film has been estimated from the GaAs longitudinal optical phonon line shape and frequency. Both the strain and the amount of disorder were found to decrease with increase in the distance from the interface.

35252 **Ion range distributions in multilayered structures: Bi in Si/Ge.** Tsao, J.Y.; Picraux, S.T.; Brice, D.K.; Wright, A.F. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 2, 513-520(15 Jul 1987). Contract AC04-76DP00789.

Bismuth-ion range distributions have been measured in Si/Ge multilayered structures by glancing-angle Rutherford-backscattering spectrometry. The structures were formed by ultrahigh vacuum deposition of various combinations of Si and Ge layers, with thicknesses ranging from 25 to 60 nm, and then implanted with Bi ions at energies ranging from 70 to 385 keV. The measured distributions exhibit, as expected, discontinuities at the Si/Ge interfaces and depend markedly both on the exact sequencing and thicknesses of the layers, as well as on the range-to-layer—thickness ratio. The measured distributions are compared to those calculated by a recently developed approximate method for determining such distributions, the method of equivalent atomic stopping (MEAS). The overall agreement is good and illustrates the usefulness of MEAS in predicting implant distributions in multilayers not yet studied experimentally.

35253 **Raman spectroscopy and melting of nitrogen between 290 and 900 K and 2.3 and 18 GPa.** Zinn, A.S.; Schiferl, D.; Nicol, M.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 2, 1267-1271(15 Jul 1987). Contract W-7405-ENG-36.

Raman spectroscopy was used to study the melting of nitrogen from 290 to 900 K at pressures from 2.3 to 18 GPa. This work, which extends the melting by a factor of 9 over previously published results was made possible by new developments in high-temperature diamond-anvil cells. The β/δ phase boundary was also determined, and the β—δ—fluid triple point was found to be at 578 +- 10 K and 9.9 +- 0.5 GPa. The Raman frequencies of the vibron in fluid N_2 and the ν_2 vibron in δ-N_2 were found to have the same pressure dependence and be independent of temperature to a good approximation. A temperature-independent pressure scale, useful to at least 900 K is approximated by $P/GPa = 0.4242\ \nu/cm^{-1} - 987.8$, where ν is the frequency of either the ν_2 vibron in δ-N_2 or the vibron in fluid-N_2.

35254 **Atomistic simulation of silicon beam deposition.** Dodson, B.W. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 2, 1068-1074(15 Jul 1987).

The mechanisms controlling low-energy (10—100 eV) beam deposition of silicon onto a relaxed (111) silicon substrate have been studied using a molecular-dynamics technique. The atomic interaction was modeled using a many-body empirical potential so that the effects of the covalent Si: Si bonding could be accurately included. 10-eV silicon atoms with near-perpendicular incidence were studied to determine the energy-loss mechanism resulting in capture and subsequent difffusion of excess vibrational energy away from the impact point. Shallower angles of incidence (5°—30°) were studied for beam energies of 20—100 eV. For incidence angles less than an energy- and orientation-dependent critical value, a new phenomenon of "surface channeling" is observed, in which the trajectory of the incoming particle is steered parallel to, and roughly 2 A above, the surface of the substrate by inelastic interaction with the surface atoms. The rate of energy loss in surface channeling trajectories is very slow, so that ranges of thousands of angstroms along the surface are possible. The phenomena observed in low-energy beam deposition offer considerable promise for precision control of the growth of nonequilibrium semiconductor structures.

35255 **Angular and polarization dependence of surface-enhanced Raman scattering in attenuated-total-reflection geometry.** Goudonnet, J.P.; Inagaki, T.; Arakawa, E.T.; Ferrell, a.T.L. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 2, 917-921(15 Jul 1987).

Polarization and angle-of-incidence dependences of the surface-enhanced Raman scattering (SERS) signal of benzoic acid adsorbed on isolated oblate particles of silver have been measured in an attenuated-total-reflection geometry. Simultaneously, the absorption of photons in the particles has been determined by a photoacoustic method. At the critical angle and in the wavelength range of the present study, only one dipole resonance mode, the nonazimuthally symmetric mode, is excited by the component of the electric field parallel to the reflecting surface. This has allowed us to evaluate contributions of the resonance absorption and the nonresonant intrinsic absorption to the total absorption. We show that the absorption of p-polarized light at the critical angle is solely due to the intrinsic absorption. No Raman signal can be detected in the absence of the surface-plasmon mode or electromagnetic resonance. We show also that the dependence of SERS on the polarization and angle of incidence can be explained by considering only the excitation of localized plasmons.

35256 **Structure and bonding of small semiconductor clusters.** Toman-acute-accentek, D.; Schluter, M.A. (Department of Physics, University of California, Berkeley and Center for Advanced Materials, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 2, 1208-1217(15 Jul 1987). Contract AC03-76SF00098.

We calculate the geometrical and electronic structure of small Si/sub n/, Si/sub n/ $^+$, and Si/sub n/ $^-$ clusters up to sites n = 14 within a combined tight-binding—density-functional-theory scheme. Especially stable structures for n = 6 and 10 coincide with observed abundancies in the experimental mass spectra. All equilibrium structures are found to be close packed, with a different bonding than found in the bulk fragments. A transition to bulklike open structures is estimated to occur at cluster sizes $n \approx 10^2$—10^3. .AE

35257 **Optical detection of metastable H/sup 2-/ defects and photoconversion of anion vacancies in thermochemically reduced CaO crystals.** Orera, V.M.; Chen, Y. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 2, 1244-1247(15 Jul 1987). Contract AC05-84OR21400.

The localized vibrational modes and electronic transitions of H/sup 2-/ defects in thermochemically reduced CaO crystals have been detected. The cause of the long-lived luminescence of the F center at room temperature is shown to be due directly to release of electrons from metastable H/sup 2-/ defects. Photoconversion between F and F^+ centers involves electron transfer via the reversible process $H^- + e^-$ bold-arrow-left-rightH/sup 2-/. .AE

35258 **Epitaxial growth of silicon: A molecular-dynamics simulation.** Schneider, M.; Schuller, I.K.; Rahman, A. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *B: Condensed Matter;* **36**: No. 2, 1340-1343(15 Jul 1987).

We have studied the epitaxial growth of silicon using molecular-dynamics techniques. The model consists of a temperature-controlled Si(111) substrate, with the Si atoms projected towards the substrate as is done in the laboratory. The atoms interact via a potential developed by Stillinger and Weber to simulate the bulk properties of Si. We find that at low substrate temperatures the growth is not well ordered; this is in accordance with experimental observation. It is precisely the opposite of what occurs in spherically symmetric potentials that were used to simulate the growth of metallic films. At higher substrate temperatures the growth is into properly stacked, crystalline Si layers. In contrast to the growth of metals (spherically symmetric potentials), the atomic mobility on the growing surface and the thermal conductivity of the system are much lower for Si; the results of this simulation and those of our previous work are in agreement with experimental observations showing, as expected, that a major determining factor in epitaxial growth of films is the nature of the interaction potential.

35259 **Novel photochemical vapor deposition reactor for amorphous silicon solar cell deposition.** Rocheleau, R.E.; Hegedus, S.S.; Buchanan, W.A.; Jackson, S.C. (Institute of Energy Conversion, University of Delaware, Newark, Delaware 19716). *Applied Physics Letters;* **51**: No. 2, 133-135(13 Jul 1987).

A novel photochemical vapor deposition (photo-CVD) reactor having a flexible ultraviolet-transparent Teflon curtain and a

secondary gas flow to eliminate deposition on the window has been used to deposit amorphous silicon films and p-i-n solar cells. The background levels of atmospheric contaminants (H_2O, CO_2, N_2) depend strongly on the vacuum procedures but not on the presence of a Teflon curtain in the reactor. Intrinsic films with a midgap density of states of 3 x 10^{15} eV^{-1} cm^{-3} and all-photo-CVD pin solar cells with efficiencies of 8.5% have been deposited.

35260 **Liquid $GeBr_4$. I. A test of the anomalous x-ray scattering method as applied to disordered materials.** Ludwig, K.F. Jr.; Warburton, W.K.; Wilson, L.; Bienenstock, A.I. (Department of Applied Physics, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **87**: No. 1, 604-612(1 Jul 1987).

This study tested the accuracy of the anomalous x-ray scattering technique as part of an investigation of the molecular liquid $GeBr_4$. The differential anomalous scattering technique proved to be quite accurate, giving nearest-neighbor coordination distances and numbers correct to 0.02 A and 4%, respectively, as compared with known values. The high accuracy of the approach evidently depends on a cancellation of systematic errors when subtracting data sets at two nearby photon energies. The straightforward three-wavelength approach to determining the partial-distribution functions is quite ill conditioned and small experimental errors cause large errors in the resulting partial distribution functions. An alternate procedure, suggested by Munro, uses differences to determine the partial distribution functions (PDF's) and hence takes advantage of the cancellation of systematic errors. This approach yields Br—Br, Ge—Br, and Ge—Ge PDF's with error levels of approximately 5%—10%, 30%, and 100%, respectively. Singular value decomposition of the weighting matrix can be used to predict the relative accuracies of the three PDF's before experimentation.

35261 **Liquid $GeBr_4$. II. Molecular packing and liquid structure.** Ludwig, K.F. Jr.; Wilson, L.; Warburton, W.K.; Bienenstock, A.I. (Department of Applied Physics, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **87**: No. 1, 613-619(1 Jul 1987).

Anomalous scattering data from l-$GeBr_4$ are compared with theoretical predictions and with several models. Published hard-sphere RISM calculations of the pair correlation functions accurately predict the features of the experimental distribution functions, but discrepancies between theory and experiment are larger than the experimental uncertainty. New calculations with more realistic potentials are needed. The total structure factor of l-$GeBr_4$ contains a prepeak which is due largely, but not exclusively, to correlations between molecular centers (i.e., germanium atoms). Modeling results indicate that there is strong interlocking of molecules in the liquid and that the Br—Br structure factor is largely determined by the packing of the halogen atoms with the germanium atoms effectively fitting in tetrahedral interstices. Models based on the monoclinic crystal of $SnBr_4$ agree better with the liquid data than models based on the cubic crystal of c-$GeBr_4$, suggesting that $GeBr_4$ undergoes a change in short-range molecular packing on melting.

35262 **X-ray studies of concentrated aqueous solutions.** Ludwig, K.F. Jr.; Warburton, W.K.; Fontaine, A. (Department of Applied Physics, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **87**: No. 1, 620-629(1 Jul 1987).

Concentrated aqueous solutions of three transition metal bromides ($ZnBr_2$, $CuBr_2$, and $NiBr_2$) and an alkali bromide (RbBr) have been studied with differential anomalous scattering (DAS) and extended x-ray absorption fine structure (EXAFS). The aq-$ZnBr_2$ solutions exhibit considerable inner-shell ion complexing with the formation of tetrahedral complexes about the Zn^{2+}. In aq-$CuBr_2$, the Cu^{2+} has an octahedral coordination shell. Most of the anions are bound directly to the cations in both solutions. In contrast, there are only a few Ni—Br nearest neighbors in aq-$NiBr_2$. Instead, cations and anions share hydrating water molecules. Preliminary data show that any ion complexing in aq-RbBr must be weak. These results are in good agreement with published thermodynamic studies.

35263 **Junction and ohmic contact formation in compound semiconductors by rapid isothermal processing.** Singh, R.; Radpour, F.; Chou, P.; Nguyen, Q.; Joshi, S.P.; Ullal, H.S.; Matson, R.J.; Asher, S. (School of Electrical Engineering and Computer Science, University of Oklahoma, Norman, Oklahoma 73019). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 1819-1823(Jul 1987).

The results of a new application of rapid isothermal processing (RIP) for the junction and ohmic contact formation in compound semiconductors are presented in this paper. In this process, for a particular compound semiconductor a compound is selected so that one element acts as a dopant and the other is one element of the compound semiconductor preferably a high vapor pressure element. A thin layer of this compound is deposited by suitable technique on top of the compound semiconductor followed by low-temperature (—300—500°C) RIP step. Results of indium phosphide and cadmium telluride are presented representing group III—V and II—VI, respectively. Preliminary results of $CuInSe_2$ are also presented. This method does not require a sealed quartz ampoule, a capping layer, or a background pressure of high vapor pressure element of the compound semiconductor, as is required in diffusion of most compound semiconductors. This process has resulted in abrupt and shallow junctions having excellent diode characteristics.

35264 **Low-temperature epitaxy of Si and Ge by direct ion beam deposition.** Zuhr, R.A.; Appleton, B.R.; Herbots, N.; Larson, B.C.; Noggle, T.S.; Pennycook, S.J. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2135-2139(Jul 1987). Contract AC05-84OR21400.

Amorphous, polycrystalline, and epitaxial thin films of Si and Ge have been grown by ion beam deposition (IBD) under ultrahigh-vacuum conditions. IBD involves the direct deposition of ions onto single-crystal substrates from mass- and energy-analyzed beams with energies of 10 to 200 eV. The IBD films were characterized by Rutherford backscattering, ion channeling, cross-section transmission electron microscopy, and x-ray diffraction. The effects of substrate temperature, ion energy, and substrate cleaning were studied. Differences in the formation of epitaxial thin films on p- and n-type Si substrates were observed with n^- Si showing better epitaxy at low temperatures. Epitaxial overlayers which showed good minimum yields by ion channeling (3%—4%) have been produced at temperatures as low as 375°C for Ge on Ge(100) and Si on Si(100).

35265 **Diagnosis and therapy for a recalcitrant parylene coater.** Williams, J.M.; Rowen, J.T. (Materials Science and Technology Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2760-2762(Jul 1987).

An in-house built parylene coater produced coatings whose thicknesses varied 50% at the 1-μm level, whose surfaces were rough and flapjacklike, and whose cross sections looked like foam. This paper details the product response to various equipment and operational changes. The systematic analysis showed that a balance of vacuum pressure and pyrolysis temperature is needed to produce good-quality coatings.

35266 **Adsorption of H_2O on planar and stepped Si(100): Structural aspects.** Larsson, C.U.S.; Johnson, A.L.; Flodstroem, A.; Madey, T.E. (Surface Science Division, National Bureau of Standards, Gaithersburg, Maryland 20899). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 842-846(Jul 1987).

The adsorption of water on two silicon surfaces [reconstructed planar (100)2 x 1 and single domain stepped (100)2 x 1 cut 5° towards (011)] was studied using low-energy electron diffraction and digital imaging electron stimulated desorption ion angular distributions (ESDIAD) as a function of temperature (145—700 K) and coverage. Water has been shown previously to chemisorb dissociatively to form surface OH groups. At 300 K the H^+ ESDIAD pattern for the planar surface is a nearly symmetric halo, indicating

that OH is oriented with its bond vector inclined away from the surface normal, while at low temperatures (≦ 200 K) a four-lobed pattern that preserves substrate symmetry is observed. This reversible temperature dependence is related to librations and rotations of the OH complexes. ESDIAD from the stepped surface exhibits a two-lobed pattern, with enhanced emission towards the steps, consistent with bonding of OH to single-domain terrace sites. An interpretation is presented based on the dimer model of the Si(100) reconstruction in which the OH bond axis azimuths are oriented nearly perpendicular to the dimer azimuths.

35267 **Evidence for the neutralization of boron in silicon using surface analysis techniques.** Kazmerski, L.L.; Nelson, A.J.; Dhere, R.G. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 1994-1997(Jul 1987). Contract AC02-83CH10093.

Interactions between the shallow acceptor boron and hydrogen in single crystal, polycrystalline, and amorphous Si are investigated. Low-temperature secondary ion mass spectrometry depth-compositional profiles indicate a definite interaction between the boron concentration and the hydrogen penetration in single crystals and at grain boundaries. The bonding of the H is identified to be directly to the Si rather than to the B, and is confirmed by infrared measurements. Electrical neutralization of the B by hydroxyl-group bonding is also reported at oxygen-rich Si grain boundaries. No similar relationships between P concentration and H penetration are observed. In amorphous Si material, the B-doping level has only a limited effect on the hydrogen penetration which seems to be controlled instead by structural diffusion mechanisms.

35268 **Electron energy-loss spectroscopy study of hydrogenated amorphous silicon.** Burnham, N.A.; Fisher, R.F.; Asher, S.E.; Kazmerski, L.L. (Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2016-2018(Jul 1987). Contract AC02-83CH10093.

Electron energy-loss spectroscopy is used to study hydrogenated amorphous silicon (a-Si:H). Core-level and plasma excitations were examined as a function of hydrogen content. This technique and its interpretation reveals a consistent picture of the electron excitations within this important material. The a-Si:H thin films were fabricated by rf sputtering. Their hydrogen concentrations ranged from 0% to 15%. Hydrogen content was determined by infrared spectroscopy and secondary ion mass spectroscopy. X-ray photoelectron spectroscopy and inspection of the silicon Auger-KLL peak confirmed the silicon core levels.

35269 **Nonlinear optical response of [111] growth axis strained-layer superlattices.** Smith, D.L.; Mailhiot, C. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2060-2064(Jul 1987).

The presence of internal strains in [111] growth axis strained-layer III—V superlattices leads to the generation of large polarization fields (exceeding 100 kV/cm) because the constituent semiconductors are piezoelectric. These strain-induced polarization fields produce a substantial reduction of the superlattice band gap and cause a spatial separation of the electrons and holes in the confining layers in such a way as to screen the internal fields. When free carriers are present to screen the strain-induced piezoelectric fields, the electronic structure (energy band gap, in-plane effective masses) and the optical response (absorption edge, optical constants) of the strained-layer superlattice depend on the density of free carriers. In the case where the electrons and holes are photogenerated, the superlattice photoabsorption profile can be modified by variations of the intensity of the optical excitation. The nonlinear optical response of strained-layer superlattices owing to free-carrier screening of strain-generated internal fields is illustrated here for the case of Ga_1/sub —//sub x/In/sub x/As—Al_1/sub —//sub y/In/sub y/As strained-layer superlattices.

35270 **Retention of hydrogen in graphite.** Langley, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2205-2209(Jul 1987). Contract AC05-84OR21400.

The retention of hydrogen in POCO AXF-5Q graphite has been measured at room temperature as a function of fluence and flux for H^+_2 ions at energies from 250 to 500 eV provided by a glow discharge. More than 2×10^{18} H/cm² has been retained, and no indication of saturation has been observed to a fluence of 5×10^{19} H/cm². In this experiment retention was found to increase linearly with fluence for constant flux. A flux dependence was observed; i.e., the retention rate was observed to decrease monotonically as the flux increased. A changeover experiment, deuterium to hydrogen, was conducted; the results show that significant changeover occurs (i.e., about 30% changeover for a fluence of 5×10^{17} D/cm²).

35271 **Quartz-crystal microbalance apparatus for water sorption by polymers.** Czanderna, A.W.; Thomas, T.M. (Materials Research Branch, Solar Energy Research Institute, Golden, Colorado 80401). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2412-2416(Jul 1987). Contract AC02-83CH10093.

A quartz-crystal microbalance (QCM) apparatus has been assembled for studying the water sorbed by polymeric materials from 0.1 to 100 μm thick. The apparatus consists of an UHV system with a turbomolecular pump, valves, low-pressure gauges, a capacitance manometer, a residual gas analyzer, and reservoirs for water vapor and other adsorbate gases. Up to five different polymer coated quartz crystals can be inserted into hangdown tubes using a 20-in.-long, water-cooled, sensor head with appropriate feedthroughs for the electrical connections and thermocouple leads. The QCM controller consists of a power supply, oscillators, frequency meter, and output for obtaining mass change data. The sensitivity of 14 ng/cm² Hz corresponds to a mass change of about 0.1% for a 100-nm-thick polymer film. Sample temperatures are controlled to better than 0.1°C by immersing the hangdown tubes in a liquid water bath. The controller is interfaced with computers for data acquisition, storage, manipulation, etc. to output data for sorption isotherms, the rate of sorption and desorption, and comparing the cyclic reproducibility of rate and capacity. Representative sorption data for three polymers are presented.

35272 **Crystallization instability at the amorphous-silicon/liquid-silicon interface.** Tsao, J.Y.; Peercy, P.S. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **58**: No. 26, 2782-2785(29 Jun 1987).

The rate at which crystalline-Si nucleates at the amorphous-Si/liquid-Si interface is estimated. On the basis of this estimate and physical arguments, we propose that under certain conditions a moving amorphous-Si/liquid-Si interface is unstable with respect to nucleation of crystalline Si. Such nucleation, followed by growth, is a possible mechanism for the well-known explosive crystallization of amorphous Si. Furthermore, a similar instability can explain the formation of amorphous Si from liquid Si.

35273 **Ferromagnetism in molecular decamethylferrocenium tetracyanoethenide (DMeFc TCNE).** Chittipeddi, S.; Cromack, K.R.; Miller, J.S.; Epstein, A.J. (Department of Physics, The Ohio State University, Columbus, Ohio 43210-1106). *Physical Review Letters;* **58**: No. 25, 2695-2698(22 Jun 1987).

The temperature and magnetic field dependence of the magnetization and susceptibility of single-crystal decamethylferrocenium tetracyanoethenide (DMeFc TCNE) demonstrate that this material is the first molecular compound with a ferromagnetic ground state. A spontaneous magnetization is observed for $T<4.8$ K. The results are consistent with a crossover from a dominance of one-dimensional ferromagnetic exchange interaction to a 3D mean-field-like interaction at —16 K. The critical exponents are in accord with mean-field behavior. A generalized Hubbard model is proposed to account for the unusual ferromagnetic exchange interactions in this system.

35274 **Electronic polaron effects in heavy-electron materials.** Liu, S.H. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **58**: No. 25, 2706-2709(22 Jun 1987). Contract AC05-84OR21400.

It is shown that intra-atomic Coulomb correlation causes the f electrons in heavy-fermion materials to propagate like polarons in insulators and semiconductors. The effective mass of the quasiparticles is enhanced, and at finite temperatures the quasiparticles are damped so that the polaron effect may be a contributing factor to the crossover from coherent behavior at low temperatures to single-site behavior at high temperatures.

35275 **Photoemission spectroscopy of ultrathin hydrogenated amorphous silicon layers.** Yang, L.; Abeles, B.; Eberhardt, W.; Stasiewski, H.; Sondericker, D. (Exxon Research and Engineering Company, Annandale, New Jersey 08801). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 17, 9395-9398(15 Jun 1987).

Photoemission spectroscopy of ultrathin hydrogenated amorphous silicon films on silicon oxide show that the interfaces are atomically abrupt. The Si 3p valence band is already developed in monolayer-thick islands. The absence of quantum-size effects associated with holes indicates that the Si 3p wave functions are localized on a scale of a few angstroms. The range of the Si 2p core-hole—exciton interaction is estimated to be 6 A.

35276 **Electronic structure of some β-(C/sub 10/H$_8$S$_8$)$_2$X compounds as studied by infrared spectroscopy.** Jacobsen, C.S.; Tanner, D.B.; Williams, J.M.; Geiser, U.; Wang, H.H. (Physics Laboratory III, Technical University of Denmark, DK-2800 Lyngby, Denmark). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 18, 9605-9613(15 Jun 1987).

Polarized reflectance measurements have been made on two isostructural conducting compounds of bis(ethylenedithio)tetrathiafulvalene [BEDT-TTF or ET, (C/sub 10/H$_8$S$_8$)]: β-(ET)$_2$AuI$_2$ and β-(ET)$_2$I$_2$Br. The former is superconducting at ambient pressure with T/sub c/ = 5 K, whereas the latter retains normal-metal conductivity to low temperatures. The reflectance measurements, made at temperatures of approximately 30 and 300 K, spanned 80 cm/sup -1/ (0.01 eV) through 33 000 cm/sup -1/ (—4 eV); they were made for polarization along the ET molecular stacking axis and transverse to it in the sheets or layers of ET molecules. Band-structure parameters determined from the plasmon frequencies imply that the anisotropy is rather low for organic conductors, with t/sub X/≅0.22 eV and t/sub perpendicular/≅0.09 eV for β-(ET)$_2$AuI$_2$; t/sub X/≅0.18 eV and t/sub perpendicular/≅0.07 eV for β-(ET)$_2$I$_2$Br. At 300 K, the spectra differ substantially from the expectations of simple one-electron models, suggesting that both electron-phonon and electron-electron interactions play important roles in the electronic structure of these materials. At low temperatures, the materials display basically metallic characteristics, yet deviate significantly from simple Drude-model behavior. At 30 K, no effect attributable to superconducting fluctuations could be observed.

35277 **Theoretical aspects of solid hydrogen halides under pressure.** Jansen, R.W.; Bertoncini, R.; Pinnick, D.A.; Katz, A.I.; Hanson, R.C.; Sankey, O.F.; O'Keeffe, M. (Department of Physics, Arizona State University, Tempe, Arizona 85287). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 18, 9830-9846(15 Jun 1987).

The electronic and dynamic properties of the solid phases of HF, HCl, and HBr under pressure are studied theoretically. A simple model is constructed so that the pressure-dependent properties of these systems and possibly other hydrogen-bonded systems can be studied in terms of a few parameters. The model predicts quite simply the pressure dependence of the stretching-mode frequency and the nature of the phase transition from the molecular hydrogen-bonded phase to a new symmetrical hydrogen-bonded (nonmolecular) phase. Quantum effects due to the light hydrogen atom are taken into account within a many-body Hartree approximation. New experimental data on the pressure dependence of the symmetric-stretching-mode frequency in HF is presented. The possibility of soliton formation is discussed and it is shown how pressure may act as a unique tuner to adjust the energetics of these nonlinear excitations. In addition, we report the results of our ab initio calculations of the total energy of ringlike structures of HF and the first ab initio pseudopotential calculation of the band structure and total energy of solid HBr. The calculations for HF are within the Hartree-Fock approximation, while those of solid HBr are within the local-density approximation and have been simplified by considering a linear instead of a zigzag geometry. The use of the local-density approximation for hydrogen is also discussed.

35278 **Determination of a natural valence-band offset: The case of HgTe-CdTe.** Shih, C.K.; Spicer, W.E. (Stanford Electronics Lab., Stanford University, Stanford, California 94305). *Physical Review Letters;* **58**: No. 24, 2594-2597(15 Jun 1987).

We propose a method to determine a natural valence-band offset (NVBO), i.e., the change in the valence-band maximum energy which is intrinsic to the bulk band structure of semiconductors. We use the Hg-Te-CdTe system as an example in which we find that the valence-band maximum of HgTe lies 0.35 +- 0.06 eV above that of CdTe. The NVBO of 0.35 eV is in good agreement with the x-ray photoemission spectroscopy measurement of the heterojunction offset. The procedure to determine the NVBO between semiconductors, and its implication of the heterojunction band line-up and the electronic structures of semiconductor alloys, are discussed.

35279 **Development of long-range order in Hg/sub 3-// sub δ/AsF$_6$ and Hg/sub 3-//sub δ/SbF$_6$.** Tun, Z.; Brown, I.D.; Axe, J.D.; Shirane, G. (Institute for Materials Research, McMaster University, Hamilton, Ontario L8S 4M1). *Physical Review* [*Section*] *B: Condensed Matter;* **35**: No. 16, 8587-8590(1 Jun 1987).

Development of long-range order between the mercury chains of Hg/sub 3-//sub δ/AsF$_6$ and Hg/sub 3-//sub δ/SbF$_6$ compounds has been studied by neutron diffraction. The results are compared to a model of long-range order in which intrachain interactions are treated exactly and interchain interactions are approximated by a mean field. For Hg/sub 3-//sub δ/SbF$_6$ the model accurately predicts the temperature dependence of the Bragg peak intensities. For Hg/sub 3-//sub δ/AsF$_6$ the intensities are found, unexpectedly, to be proportional to the first power rather than the square of the calculated order parameter.

35280 **Nonlinear refractive-index measurements of glasses using three-wave frequency mixing.** Adair, R.; Chase, L.L.; Payne, S.A. (Lawrence Livermore National Laboratory, University of California, P.O. Box 5508, L-490, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 6, 875-881(Jun 1987). Contract W-7405-ENG-48.

We have developed a rapid and accurate method for measuring the nonlinear refractive index of transparent materials. It is based on a version of three-wave mixing in which the frequencies of the two input beams are adjusted to differ by about 60 cm^{-1}. The nonlinear index of a material relative to that of a standard with a known index. Our measurements of 27 glasses are in good agreement with previous results, where available, and with the n_2 values calculated empirically from linear parameters. We also discuss the relationship between the observed nonlinear index and the structure and composition of the glasses.

35281 **Second-order nonlinear polarizability of various biphenyl derivatives.** Berkovic, G.; Rasing, T.; Shen, Y.R. (Center for Advanced Materials, Lawrence Berkeley Laboratory, Department of Physics, University of California, Berkeley, California 94720). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 6, 945-949(Jun 1987). Contract AC03-76SF00098.

The second-order nonlinear polarizabilities of several organic molecules derived from the cyanobiphenyl structure are compared by using second-harmonic generation from molecular monolayers. Changes in optical nonlinearity with changes in molecular structure are discussed.

35282 **X-ray diffraction studies of organic monolayers on the surface of water.** Dutta, P.; Peng, J.B.; Lin, B.; Ketterson, J.B.; Prakash, M.; Georgopoulos, P.; Ehrlich, S. (Department of Physics and Astronomy, Northwestern University, Evanston, Illinois 60201). *Physical Review Letters;* **58**: No. 21, 2228-2231(25 May 1987).

We have used synchrotron radiation to study organic monolayers on water ("Langmuir films"). At high monolayer pressures, lead stearate [Pb(C/sub 17/H/sub 35/COO)$_2$] shows a powder peak at 1.60 A/sup -1/, implying an area per unit cell of 17.8 A^2 if the lattice is triangular. The correlation length is about 250 A. Lignoceric acid (C/sub 23/H/sub 47/COOH) shows a similar peak even though no heavy ions are attached. When the pressure is reduced, the peak in lead stearate does not observably move or broaden; below the "knee" in the isotherm, however, the peak height decreases slowly with increasing area, implying a first-order melting transition.

35283 **Enhanced ionic conduction in AgCl-Al/sub 2/O/sub 3/ composites induced by plastic deformation.** Dudney, N.J. (Solid-State Div., Oak Ridge National Lab., Oak Ridge, TN). *Journal of the American Ceramic Society;* 70: No. 2, 65-68(Feb 1987). Contract AC05-84OR21400.

Composites of AgCl and Al/sub 2/O/sub 3/ were prepared by impregnating an alumina fiber paper with molten AgCl. The as-prepared composites showed no enhancement in the conductivity compared with pure AgCl samples prepared in a similar manner. When plastically deformed, the conductivity of both the pure and composite materials increased. After annealing at high temperatures, the conductivity of the pure AgCl sample decreased to the as-prepared value, whereas the composite maintained a 2- to 5-fold enhanced conductivity.

35284 **Laser spectroscopy of chemical vapor deposition.** Breiland, W.G.; Ho, P.; Coltrin, M.E. (Sandia National Labs., Albuquerque, NM 87185). pp 38-41 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WD1.

Chemical vapor deposition (CVD) is an important industrial process used to deposit solid films for protective coatings and microelectronic applications. The CVD processes used in the fabrication of microelectronic devices are becoming more complex, and higher demands are being made on the resulting films. A fundamental understanding of the chemistry and physics of CVD may help meet future process control requirements, and could lead to novel deposition methods. The authors pursue a coordinated experimental and theoretical program to investigate the fundamental mechanisms of CVD. The experimental part of the program involves the use of laser spectroscopic techniques for in situ measurements of the gas phase in a research CVD reactor. The theoretical part of the program consists of modeling of the coupled fluid mechanics and the gas-phase chemical kinetics of silane decomposition and subsequent reactions of intermediate species. We have initially chosen to concentrate on the silane CVD system, although the techniques and principles involved are applicable to more complex systems. This paper summarizes the experimental and theoretical research.

35285 **Raman analysis of inorganic thin films.** Tallant, D.R.; Higgins, K.L.; Hargis, P.J.; Stewart, A.F. (Sandia National Labs., Albuquerque, NM 87185-5800). pp 6-11 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WA3.

Techniques for the Raman analysis of plasma-deposited submicrometer silicon films on metallic substrates and dielectric films on Raman-active substrates are described and typical results are presented.

35286 **Laser mapping of Al-h/sup +/ impurity distribution in vacuum swept crystalline quartz.** Anthes, J.P.; Garcia, P.; Koehler, D.R. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). pp 20-23 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WB3.

The authors have used HeNe laser light absorption to perform 2-D spatial mapping of hole-compensated aluminum (Al-h/sup +/) impurity sites produced during vacuum sweeping of crystalline quartz. Application of an electric field parallel to the optic axis cna produce a hole trapped at a non-bonding oxygen ion (A10/sub 4/)^0 site. These hole-compensated Al-h/sup +/ sites introduce color center absorption. The electro-diffusion process (sweeping) is performed under elevated temperature and vacuum conditions. The diffusion process produces a time-dependent spatial distribution of the Al-h/sup +/ centers and associated A/sub 1/-band optical absorption which is coincident with the 633-nm-HeNe laser wavelength. Spatial variations in the A/sub 1/-band absorption for swept quartz and for quartz subjected to ionizing radiation are correlated with the observed /sup (1)/ coloration. Devices fabricated from crystalline quartz with hole-compensated aluminum impurity sites are resistant to the effects of ionizing radiation. The 2-D mapping of optical absorption is compared to electron spin resonance (ESR) measurements of aluminum impurity concentration in samples of vacuum swept cultured quartz.

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4001 Analytical And Separations Chemistry

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35287 **(AD-A—178575/7/XAB) Preparation and ion-exchange properties of zirconium sulphosphosphonates.** Yang, C.Y.; Clearfield, A. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1987. 10p. NTIS, PC A02/MF A01.

Pub. in Reactive Polymers, Vol. 5, 13-21(1987).

A number of layered zirconium phosphite arylphosphonate and zirconium phosphate arylphosphonate mixed derivatives were prepared. These compounds were readily sulfonated in fuming sulfuric acid and the resultant sulfonates behaved as strong-acid ion exchangers. In the case where the aryl group bridged across layers, a non-swelling exchanger resulted, and these solids showed ion exclusion towards large complexes. They also exhibited the selectivity sequences lithium + greater than sodium + less than potassium + and magnesium + greater than calcium + less than barium +. In the exchanger in which the layers were not connected, large degrees of swelling to the point of colloid formation, were observed. As a consequence, the rates of exchange were very high. The noncrosslinked exchanger showed increased selectivity was remarkable and may stem from a combination of favorable electrostatic and steric factors.

35288 (BNL—39542, pp 41) **Specific molecular property detectors for chromatographic analysis.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This research focuses on the development of novel specific molecular property detectors for use in gas and liquid chromatographic analyses. Detection schemes are being devised which simplify the separation analyses by increasing the detector response for the specific molecules of interest while reducing the background noise from potential interferences. Areas of application range from process monitoring to trace analysis in environmental and biomedical investigations. Circular dichroism (CD) was employed as a detection technique in gas chromatography (GC) for specific monitoring of optically active compounds which absorb in the vacuum ultraviolet (VUV) region. The synchrotron radiation from U9A beamline of National Synchrotron Light Source was used as the light source. The detection limits established using GC-VUV-CD system are at the nanogram levels for a selected group of hydrocarbons.

35289 (BNL—39542, pp 42) **Stationary-phase advances and novel detection principles for analytical chromatography.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This project focuses on improving separation capabilities in analytical chromatography through several parallel approaches. One strategy seeks increased selectivity in capillary gas chromatography (GC) by preparing cross-linked stationary phases of varying polarity with in situ generated low-temperature plasmas. Plasmas appear uniquely suited for several different preparation steps including: cleaning, deactivation, cross-linking of stationary phases, and modifying stationary-phase polarity. Selectivity improvements in condensed-phase separations (liquid and supercritical mobile phases) are anticipated in the second area of investigation involving mesomorphic liquid-crystalline stationary phases. Results are expected analogous to the use of these materials in GC. A third approach is to enhance column performance in liquid chromatography (LC) by isolating uniform fractions of silica-based packing material ranging from 1 to 2 μm. Packing techniques will be studied. Peak asymmetry, column permeability, and column efficiency will be related to packing structure. A fourth area of emphasis seeks improved detection sensitivity for a wide range of chemical species. Radiolytic/photolytic reactions and energetic species coupled with various detection schemes will be investigated for LC and supercritical fluid chromatography (SFC). Finally, computer modeling and optimization studies will support and coordinate advances in the above areas.

35290 (BNL—39542, pp 59) **Analytical chemistry group.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This is a service group dedicated mainly to fulfilling the analytical chemistry requirements of the Department of Applied Science and thereby presently devotes most of its efforts to the programmatic needs of the Environmental Chemistry and Atmospheric Sciences Divisions. However, their services, both through analytical chemical measurements and direct programmatic involvement, are available for and indeed used by the rest of the Department and the Laboratory as a whole. Most samples are submitted for analyses to be performed at the central analytical facility, but when the need for more intensive analytical support dictates, chemists from the group are loaned for various periods of time to other Divisions and Departments within the Laboratory. The analytical techniques most frequently utilized are ion chromatography, automated colorimetry, atomic absorption, spectrophotometry, liquid and gas chromatography, and mass spectrometry. Computer-assisted data analysis has been instituted for several of these techniques.

35291 (DOE/ER/13113—2) **Systematic and structural studies of homogeneous and polymeric extractants for the separation and recovery of metal ions: Progress report, August 1, 1985-July 31, 1986.** Alexandratos, S.D. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Jul 1985. Contract AS05-83ER13113. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010089.

We have introduced a new class of bifunctional polymer-supported extractants for use in metal ion recovery processes. These resins incorporate primary (monoaryl) phosphinic acid/secondary (diaryl) phosphine oxide ligands or a combination of primary and secondary phosphinic acid ligands, depending on the method of synthesis. Additionally, we have discovered that these bifunctional polymers operate by a unique dual mechanism in that they will ion exchange with a given metal ion in acidic solutions and then reduce it to its zerovalent state if it has an appropriate reduction potential. The concept of "dual mechanism bifunctional polymers" has thus been established to describe phosphinic acid resins and their derivatives. Initial work with the phosphinic acid resins examined their ion exchange ability when contacted with aqueous solutions of zinc and compared their performance with polystyrene-supported sulfonic and carboxylic resins. The phosphinic resins display superior ion exchange properties than either the sulfonic or carboxylic resins. We have explained this greater selectivity for the transition metal ions on the part of the phosphinic resins on the basis of contact ion pair formation occurring during the ion exchange process.

35292 (DOE/ER/13113—3) **Systematic and structural studies of homogeneous and polymeric extractants for the separation and recovery of metal ion: Triennial performance report, August 1, 1983-July 31, 1986.** Alexandratos, S.D. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Apr 1986. Contract AS05-83ER13113. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010090.

Novel polymeric extractants have been synthesized and applied to the recovery of metal ions from dilute aqueous solutions. The new category of dual mechanism bifunctional polymers is introduced as a series of resins which permit highly selective extractions through the use of a reaction additional to ion exchange in the recovery process. The bifunctional phosphinic acid ion exchange/redox resins form the first class of resins within this category. Their synthesis and the recovery of metallic mercury, silver, gold, and copper from their ionic solutions is detailed. Under equilibrium conditions, these resins operate entirely by the redox mechanism until all of the primary phosphinic acid sites are oxidized, followed then by purely ion exchange. Kinetic studies show that the cation's reduction potential determines whether a redox reaction will occur while, at a given reduction potential, the oxidation state determines how rapidly. The significant coordinative ability of the phosphoryl oxygen is also important, though, and is responsible for extracting greater amounts of actinide ions than the sulfonic resins. For those processes where membranes would most appropriately be applied, the modification of polypropylene with interpenetrating polymer network extractants yields a recovery system with almost infinite lifetime. Such networks have been formed from polymers of di(undecenyl) phosphoric acid and found to display significantly enhanced retention within polystyrene bead supports. 10 refs.

35293 (DOE/ER/13281—3) **Novel approaches to ionic chromatography: Progress report, November 1, 1986-November 30, 1987 .** Dasgupta, P.K. (Texas Tech Univ., Lubbock (USA). Dept. of Chemistry and Biochemistry). 1987. Contract FG05-84ER13281. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010698.

This report summarizes the major accomplishments under the following headings: membrane suppressors for ionic chromatography; metal ion chromatography; postcolumn reagents; optical detectors and optical detection methods; anion chromatography; and elution and detection methods. (DLC)

35294 (GKSS—85/E/65) **Multielement analysis of environmental samples by total-reflection X-ray fluorescence spectrometry, neutron activation analysis and inductively coupled plasma optical emission spectroscopy.** Michaelis, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1986. 14p. NTIS, PC E07; Available from NTIS as TIB/B87-01422.

Special print from Fresenius Z. Anal. Chem. (Aug 1986) Vol. 324(7) p. 662-671.

In environmental research and protection trace elements have to be determined over a wide range of atomic number, down to very low concentrations, and in quite different matrices. This challenge requires the availability of complementary analytical methods characterized by a high detection power and few sources of systematic errors. Besides, the capacity of multielement detection is often desired since it facilitates the tackling of many problems in which numerous trace elements are of direct concern. Total-reflection X-ray fluorescence, neutron activation analysis and inductively coupled plasma optical emission spectroscopy, in principle, fulfill these requirements quite well. However, each method has its domain, and the application to certain sample species may be less promising. Under this aspect, the paper summarizes some recent developments and investigations, including intercomparisons as far as possible. Various matrices are considered: rainwater and airborne particulates, soil samples, river sediments and suspended particulate matter, river water filtrates, ovean water, and organic matrices. Capabilities and limitations are discussed. Sample preparation techniques are described if they are new or essential for achieving the results given.

35295 **(PB—87-160479/XAB) Matrix effects in compositional analysis of bulk materials by PGNAA (prompt gamma/neutron activation analysis). Final report.** Rogers, V.C.; Sandquist, G.M.; Merrell, G.B.; Gozani, T. (Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)). Aug 1984. 52p. (RAE—52-1). NTIS, PC A04/MF A01.

This feasibility study has identified and evaluated the influence of important matrix effects which arise in the commercial application of prompt gamma/neutron activation analysis (PGNAA) methods to bulk-coal analysis as follows: neutron moderation and absorption changes; gamma-ray attenuation in the sample; sample density and volume changes. The neutron-induced capture gamma spectra were found to vary in a similar, predictable manner for all neutron absorbers found in coal such as hydrogen, boron, nitrogen, chlorine, and sulfur. Three different models have been proposed from this study to analyze coal by PGNAA methods and account for the significant matrix effects arising from hydrogen variation and other system perturbations.

35296 **(PNL-SA—14251) Adaptation and implementation of the RAYGUN gamma-ray analysis code on the IBM PC.** Hensley, W.K.; Lepel, E.A.; Yuly, M.E.; Abel, K.H. (Pacific Northwest Lab., Richland, WA (USA); Los Alamos National Lab., NM (USA)). Mar 1987. Contract AC06-76RL01830. 23p. (CONF-870430—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011150.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

The RAYGUN gamma-ray analysis code (a descendant of GAMANAL and GRPANL) has been converted from FORTRAN IV to RATFOR and ported to the IBM PC environment. The history of the code and some of the problems encountered during the conversion are discussed. The converted code was then used to analyze the IAEA G-1 Intercomparison Spectra as one measure of the codes performance. Results of the analyses showed that although the intrinsic peak finding and multiplet resolution capabilities of the code are a bit weak, the UPPER LIMIT and LIBRARY SEARCH options work quite well. When appropriate gamma-ray libraries are created, the overall performance of the code is quite satisfactory. The RAYGUN code runs on an IBM PC or clone with 256 Kbytes of RAM.

35297 **(UCRL—91576) Analysis of plutonium gamma-ray spectra by small portable computers.** Ruhter, W.; Gunnink, R.; Camp, D.; DeCarolis, M. (Lawrence Livermore National Lab., CA (USA); International Atomic Energy Agency, Vienna (Austria)). 15 May 1985. Contract W-7405-ENG-48. 9p. (CONF-850556—18). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008479.

From 7. symposium on safeguards and nuclear material management; Liege, Belgium (21 May 1985).

A sophisticated program for isotopic analysis of plutonium gamma-ray spectra using small computers has been developed. It is implemented on a DEC LSI-11/2 configured in a portable unit without a mass storage device for use by IAEA inspectors in the field. Only the positions of the 148-keV ^{241}Pu and 208-keV ^{237}U peaks are needed as input. Analysis is completed in 90 seconds by fitting isotopic component response functions to peak multiplets. 9 refs., 2 figs., 1 tab.

35298 **Absolute concentration measurements of atomic hydrogen in subatmospheric premixed $H_2/O_2/N_2$ flat flames with photoionization controlled-loss spectroscopy.** Salmon, J.T.; Laurendeau, N.M. (Purdue University, School of Mechanical Engineering, Flame Diagnostics Laboratory, West Lafayette, Indiana 47907). *Applied Optics;* **26**: No. 14, 2881-2899(15 Jul 1987).

An experimental protocol, using photoionization controlled-loss spectroscopy (PICLS), has been developed for obtaining absolute number densities of atomic hydrogen from laser-induced fluorescence measurements in flames. Two laser beams are employed, the first to excite hydrogen atoms from the ground state to the second excited state via two-photon absorption and the second to strongly photoionize the excited atoms. The resulting fluorescence measurements are independent of quenching. A model is presented that assures the viability of PICLS as long as the photoionization rate is greater than or equal to the quenching rate. The model is verified in fuel-lean, stoichiometric, and fuel-rich flat premixed $H_2/O_2/N_2$ flames at pressures of 20 and 72 Torr. Over this range in pressure, the ratio of number densities obtained from PICLS to those calculated from partial equilibrium is constant to within 20%. Most of the error arises from the sensitivity of the partial equilibrium calculations to small uncertainties in both the fuel-oxidizer ratio and the measured OH concentration. Because of the quenching-independent nature of PICLS, quantitative fluorescene measurements can be made by calibrating at a single favorable flame condition.

35299 **Shape-selective contribution to chemical separation: experiment.** Wirth, M.J.; Hahn, D.A. (Univ. of Delaware, Newark). *Journal of Physical Chemistry;* **91**: No. 11, 3099-3102(21 May 1987). Contract W-7405-ENG-48.

The separation process of the dimethylanpththalene isomers is studied experimentally for the solvent pair n-dodecane and acetonitrile-water. Shape-selective contributions to the chemical potential are measured spectroscopically, which is shown to be a valuable approach to separation studies. Three contributions, shape selectivity, attractions, and hydrophobic interactions, are determined by multiple regression. The results show that both shape selectivity and dipolar interactions are important in the extraction separation of the isomers. The mechanistic studies are extended to the isomer separations by the bonded phase octadecylsilane (ODS). It is found, by contrast, that the ODS phase separates the isomers by hydrophobic interactions. This interpretation is strongly supported by recent structural studies of the ODS phase.

35300 **Helium inductively coupled plasma: Background spectra emitted in the red and near-infrared spectral regions.** Chan, S.; Montaser, A. (Department of Chemistry, The George Washington University, Washington, DC 20052). *Applied Spectroscopy;* **41**: No. 4, 545-552(May 1987).

The atomic emission spectrum of a He ICP, generated in a low-gas-flow torch, was recorded for the wavelength range of 630 to 950 nm. In general, the background spectrum of the He ICP is much simpler than that of an Ar ICP. In contrast to the Ar ICP, prominent lines of Br, C, Cl, I, and S in the He ICP are free from spectral interferences.

35301 **Infrared spectroscopy of surface films and powders using a metal light pipe (theory).** Hansen, W.N.; Hansen, G.J. (Utah State University, Logan, Utah 84322 (W.N.H.); and Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (G.J.H.)). *Applied Spectroscopy;* **41**: No. 4, 553-561(May 1987).

A theory is presented for metal light pipe spectroscopy in the infrared. Methods are described for producing sensitive spectra of thin films and powders inside the pipe. Propagation of infrared radiation down the pipe is analyzed. Sensitivities and resultant spectral shapes are predicted. There is a discussion about how to get optimum signal-to-noise ratios for instrument drift-limited spectra typical of FT-IR spectroscopy in the present application. Considered in the optical theory are the effects of skew rays, effects of light scattering, effects of pipe bending, and the presence of absorbing gasses. The method is predicted to be ideal for monolayer absorption spectroscopy.

35302 **Infrared spectroscopy of surface films and powders using a metal light pipe (experimental).** Hansen, W.N.; Andrew, J.F.; Hansen, G.J. (Utah State University, Logan, Utah 84322 (W.N.H.); Los Alamos National Laboratory, Los Alamos, New Mexico 87545 (J.F.A., G.J.H.)). *Applied Spectroscopy;* **41**: No. 4, 562-566(May 1987).

Light pipe infrared spectra of adsorbed layers and powders are shown. They are compared with specular external reflection, ATR, KBr pellet transmission, and diffuse reflection spectra. The resultant light pipe spectra are found to obey the predictions of the theory presented in the previous companion paper [Appl. Spectrosc. 41, 46—62 (1987)], including the high sensitivity and S/N predicted to be attainable. They are easy to obtain and to interpret. Only fractions of a milligram of sample are required in favorable cases. The light pipe is convenient as a reaction cell, allowing changing spectra to be followed in real time. In the previous paper

were presented equations for absorption spectra of thin layers of material on the inner surface of a light pipe, in the infrared. In the present paper the equations are tested against experimental reality. These tests are a crucial verification of the theory.

35303 **Analysis of metals at a distance using laser-induced breakdown spectroscopy.** Cremers, D.A. (Chemical and Laser Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Spectroscopy;* **41**: No. 4, 572-578(May 1987).

Laser-induced Breakdown Spectroscopy (LIBS) has been used to provide a rapid analysis of metals at distances between 0.5 and 2.4 m from the focusing lens and light-collection optics. The laser sparks were generated with the use of pulses from a Nd:YAG laser, and the spark light was collected by the use of a fiber optic cable. The wide acceptance angle of the cable relaxed the constraint that the spark be formed at precise location for maximum light-collection efficiency and allowed the detection system to be placed remote from the sample. The identification of the main elemental component of eight metals using lines over a 40-nm spectral region was demonstrated by the use of a single laser pulse to record each spectrum. The accuracy and precision of analysis of the minor constituents of steel were determined, and the effect of surface contamination was examined. The application of LIBS to some industrial monitoring situations is discussed.

35304 **Relative ionization yields for impurity elements in laser mass spectrometry of steels and brasses.** Huang, L.Q.; Conzemius, R.J.; Houk, R.S. (Ames Laboratory—U.S. Department of Energy and Department of Chemistry, Iowa State University, Ames, Iowa 50011). *Applied Spectroscopy;* **41**: No. 4, 667-670(May 1987). Contract W-7405-ENG-82.

Relative sensitivity factors (RSF) are studied for impurity elements in metal samples with the use of laser mass spectrometry in the power density range of 1 to 3 x 10^9 W cm^{-2} for the focused laser beam. Metallic impurities are found to have RSFs near unity, while nonmetallic impurities are less efficiently ionized relative to iron. The results indicate uniform sensitivities for all the elements may be expected as the power density reaches 5 x 10^9 W cm^{-2}, in agreement with earlier studies.

35305 **Diffuse reflectance FT-IR studies of the adsorption of CO on Rh/Al_2O_3 catalysts.** Hamadeh, I.M.; Griffiths, P.R. (Department of Chemistry, Ohio University, Athens, Ohio 45701 (I.M.H.); and Department of Chemistry, University of California, Riverside, California 92521 (P.R.G.)). *Applied Spectroscopy;* **41**: No. 4, 682-687(May 1987).

The diffuse reflectance/FT-IR spectrum of $CO/Rh/Al_2O_3$ system has been investigated in terms of pretreatment of the catalyst, Rh loading, CO pressure (coverage), and coadsorptionof CO with oxygen. The widths of all bands were narrowed by Fourier self-deconvolution (FSD), and six types of CO/Rh adsorbed species, including two which have not been assigned previously, have been identified by their C-O stretching frequencies. Species I, assigned to $Rh(I)(CO)_2$, is formed with isolated RH atoms and/or edge Rh atoms of atomic "rafts" and/or atomic crystallites. Species II is assigned to Rh(O)-CO. Species III' is assigned to $[Rh(O)]_2CO$. Species VI is assigned to $[Rh(I)]_2CO$. Two new species-IIIa, assigned to $[Rh(O)]_3CO$, with underlying Rh atom, and Vi', assigned to $[Rh(I)]_2$ $(CO)_3$-are postulated.

35306 **Resonance ionization mass spectrometry using ion-beam sampling.** Goeringer, D.E.; Christie, W.H. (Analytical Chemistry Div., P.O. Box Y, Bldg. 9735, Oak Ridge National Lab., Oak Ridge, TN 37831). pp 101-105 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

THC2.

Sputter atomization/resonance ionization mass spectrometry (SA/RIMS) is a highly sensitive technique for materials analysis which combines ion beam sputtering, resonance ionization, and mass spectrometry. A pulsed beam of high-energy primary ions bombards the sample producing a plume of neutral atoms. The cloud of sputtered neutrals is intersected and ionized by a synchronized, pulsed laser beam tuned to a resonant transition for specific sample atoms. Laser-generated ions are then extracted into a mass spectrometer for mass analysis. Ion beam sputtering allows the sampling process to be highly controlled by varying the energy, current density, and composition of the primary beam; then pulsed nature of the beam results in efficient sample utilization. Use of a micro-focused beam permits imaging of small areas and particles. The pulsed dye laser generates the high optical power necessary to efficiently ionize the sputtered atoms. Mass analysis of the laser-generated ions provides the capability for isotope ratio measurements.

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REFER ALSO TO CITATION(S) 34475, 34481, 34550, 34583, 34815, 35171, 35233, 35260, 35261, 35281, 35349, 35687, 36108

35307 **(AD-A—178349/7/XAB) Low temperature effects on sorption, hydrolysis and photolysis, of organophosphonates: a literature review. Special report.** Britton, K.B. (New Hampshire Univ., Durham (USA). Dept. of Chemistry). Dec 1986. 82p. NTIS, PC A05/MF A01.

A survey was made of the open literature to determine the information available on the persistence of organophosphonate chemical agents in the environment. This review focuses on low-temperature hydrolytic and photolytic degradation of the nerve agents GA (Tabun), GB (Sarin), GD (Soman) and VX. The role of adsorption to ice, snow, and frozen soils and sediments is also discussed in relation to these degradative processes. Suggestions are made for the investigation of agent decomposition using simulants. The method proposed for the study of agent persistence is based on the use of linear-free-energy relationships, which should allow for more-reliable prediction of agent behavior than if a single simulant is used as a model compound.

35308 **(CONF-870724—1) EMP [electromagnetic] coupling to shielded cables.** Agouridis, D.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87004909.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Electromagnetic coupling to shielded cables is analyzed in terms of two electromagnetically coupled transmission lines excited by distributed sources. This analysis results in two traveling waves on the shield and four traveling waves in the core of the cable. Transient waveforms are reported from EMP coupling on an overhead RG-58 cable.

35309 **(DOE/ER/05226—5A) Methane activation by the lanthanide oxides: [1987 progress report, Part A].** Campbell, K.D.; Zhang, H.; Lunsford, J.H. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 1987. Contract AS05-76ER05226. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010951.

The catalytic production of gas phase methyl radicals from methane over the lanthanide oxides was measured using a matrix isolation electron spin resonance (MIESR) technique. Results show that metal centers with multiple stable oxidation states are not a requirement for activity. The oxide with the greatest activity per gram was hydrothermally treated La_2O_3, which was ca. 5 times more active than the next highest oxide. Hydrothermally treated La_2O_3 and Sm_2O_3 have the largest activities per m^2. Results obtained in a conventional flow reactor for selected oxides incidate that the CH_4 conversions per m^2 are in the order $Nd_2O_3 > La_2O_3 > Sm_2O_3 > Dy_2O_3 > CeO_2$. Oxidative coupling of CH_4 results in C_2H_6 and C_2H_4 (C_2 compounds), and the combined C_2 yields follow the same order with $Dy_2O_3 >> CeO_2$. The MIESR and flow reactor results are in qualitative agreement, with the exception of Nd_2O_3.

35310 **(DOE/ER/05226—5B) Gas phase coupling of methyl radicals during the catalytic partial oxidation of methane.** Campbell, K.D.; Morales, E.; Lunsford, J.H. (Texas A and M Univ., College Station (USA). Dept. of Chemistry). 8 Jun 1987. Contract AS05-76ER05226. 10p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011189.

The rate of gas phase CH_3/sup ./ radical formation over a lithium-promoted MgO catalyst was measured using the MIESR technique and this result was compared to the overall rate of C_2H_6 formation. It was found that at least 40% of the C_2H_6 produced could be accounted for by the coupling of gas phase CH_3/sup ./ radicals. A 2nd order rate constant for gas phase CH_3/sup ./ radical coupling of 1.1×10^{-11} cm^3 $radical^{-1}$ s^{-1} was determined for 670°C. The results show that gas phase coupling of CH_3/sup ./ radicals represents a major mechanistic pathway for the formation of C_2H_6 during the catalytic oxidative coupling of CH_4.

35311 **(DOE/ER/10502—T1) Catalytic steam gasification of carbon: Final report, 3/1/84-2/28/87.** Boudart, M. (Stanford Univ., CA (USA). Dept. of Chemical Engineering). 1987. Contract AS03-79ER10502. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010658.

Work for this grant period covers two areas: formation of coke on the platinum surface of reforming catalysts, and the preparation, surface reactivity, and catalytic activity of high specific surface area molybdenum and tungsten carbides.

35312 **(DOE/ER/10755—5) State-to-state unimolecular reaction dynamics: Technical progress report.** Crim, F.F. (Wisconsin Univ., Madison (USA)). 1986. Contract AC02-80ER10755. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011200.

The combination of a selective excitation technique with spectroscopic product detection provides new experimental data on the dynamics of unimolecular reactions. In these experiments, direct excitation of overtone vibrations prepares highly vibrationally excited molecules and time-resolved spectroscopic detection monitors reaction products, often at the level of individual quantum states. We have studied the unimolecular decomposition of a nearly monoenergetic cyclic peroxide, tetramethyldioxetane, in a free-jet expansion and have directly measured its unimolecular decay rate. The vibrational overtone spectroscopy of the molecule in the expansion reveals previously unobserved inhomogeneous structure that is a significant factor in determining the lineshapes. Measurements on hydrogen peroxide in a low pressure gas have produced new spectroscopic and dynamic data, as well. We detect individual rotational states of the OH fragment from the vibrational overtone initiated unimolecular dissociation of HOOH and obtain vibrational overtone excitation spectra by varying the excitation laser wavelength. Two-photon vibrational overtone predissociation spectroscopic measurements can now be made. Different statistical models can be used to describe the unimolecular decay dynamics of small polyatomic molecules.

35313 **(DOE/ER/13529—1) Molecular orbital studies of the bonding in heavy element organometallics: Progress report.** Bursten, B.E. (Ohio State Univ., Columbus (USA). Dept. of Chemistry). 23 Apr 1987. Contract FG02-86ER13529. 13p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010797.

Areas in which progress has been made in understanding the bonding in heavy element complexes are: general bonding scheme for mononuclear organoactinide complexes; bonding in unsupported actinide heterobimetallic complexes; f-orbital to carbonyl 2π backbonding; bonding at the Cp_3U binding site; direct actinide-to-actinide bonding.

35314 **(DOE/ER/13615—1) Catalytic hydrogenation of carbon monoxide: Research progress report, September 15, 1986-September 14, 1987.** Wayland, B.B. (Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry). Jun 1987. Contract FG02-86ER13615. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011071.

The principal objective of this program is to learn how to utilize the unique properties of rhodium porphyrins and related metallo species in achieving catalytic hydrogenation of carbon monoxide at mild conditions. Rhodium porphyrins react with H_2 and CO at pressures less than one atmosphere to produce a metalloformyl complex which is a primary intermediate in the hydrogenation of CO. Several catalytic schemes are proposed which take advantage of the unique reactivity of rhodium porphyrins coupled with the aldehyde like character of the metalloformyl intermediate. Multifunctional catalysts that utilize rhodium porphyrins and a second catalyst known to promote the hydrogenation of aldehydes are particularly promising candidates for achieving low pressure hydrogenation of CO. Solvent effects are being explored as one means of tuning the thermodynamic and kinetic parameters for optimum catalytic behavior. Results from studies of the rhodium porphyrin system provide a guide in designing new materials that retain the favorable thermodynamic factors but that have improved reaction kinetics. Comparative studies utilizing variation of the ligand array and central metal (Co,Rh,Ir) are being used to optimize the desired catalyst behavior.

35315 **(DOE/ER/60487—1) Development of more efficacious Tc-99m organ imaging agents for use in nuclear medicine by analytical characterization of radiopharmaceutical mixtures: Progress report for period September 1, 1986-August 31, 1987.** Heineman, W.R. (Cincinnati Univ., OH (USA). Dept. of Chemistry). Jun 1987. Contract FG02-86ER60487. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010822.

The long-range objective of this research is the development of more efficacious technetium-99m radiopharmaceuticals for use as imaging agents in diagnostic nuclear medicine. The author developed analytical techniques that are capable of separating radiopharmaceutical mixtures into their component technetium complexes for subsequent evaluation. During this one-year period, a chromatographic procedure has been developed for the separation of technetium phosphonoacetic acid (PAA) complexes and five Tc-PAA complexes have been isolated from radiopharmaceutical preparations. The concentration of each complex in the preparation varies significantly depending on the pH of the preparation. Radiopharmaceutical preparations based on the ligand methylene diphosphonate (MDP) have been prepared by electrochemical reduction of TcO_4^-. The yields of different Tc-MDP complexes are affected by the potential applied to the electrochemical cell. The control of both potential and pH enables a specific Tc-MDP complex to be produced in purer form and higher yield than by chemical reduction. An EXAFS spectrum of a solution of chromatographically isolated Tc-HEDP (hydroxyethylidine diphosphonate) complex shows evidence for a Tc-Tc bond, which is supportive of the postulated oligomeric/polymeric nature of these complexes. 9 refs., 4 figs.

35316 **(DOE/ET/33006—005) Plasma separation process: Quarterly technical report for period 1 January 1987 through 31 March 1987.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). 1987. Contract AC03-77ET33006. 111p. NTIS, PC A06. File Number DE87009308.

During the report period the program plan for closeout of the Plasma Separation Process (PSP) program was established and the schedule implemented as shown in Figure 1. The program plan provides for carrying out the planned activities in a manner which preserves the hardware, software and associated documentation developed during the program and transfers the hardware to DOE in a condition which allows reassembly and restart of the process at a future date. The program consists of three phases: (1) operations shutdown, planning, initial radiation surveys and M2B deactivation; (2) magnet warmup and initial decontamination operations; and (3) complete PSP closeout. All Phase 1 activities have now been completed and Phase 2 activities initiated. A summary of these activities is presented in this report with selected topics detailed in the Appendix.

35317 **(DOE/PC/80526—T7) Chemical trapping of CO/H_2 surface species: Quarterly report.** Blackmond, D.G.; Wender, I. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Jun 1987. Contract FG22-85PC80526. 6p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011068.

The work on the project during the last quarter has focused on the continuation of in-situ trapping reactions, ethyliodide being the trapping agent this time, and on the preliminary experiments using the model organometallic complexes. Both of these thrusts added to our understanding of the system and led to the decisions of extending the experimental work, for the future studies, to the use of (1) labelled compounds and GC-MS analysis for the in-situ reaction work, and (2) supported organometallic complexes for the model complex trapping reactions. CO hydrogenation reaction was carried out on RuKy catalyst. The experimental system, catalyst preparation and pretreatment conditions, and the reaction conditions were the same as those used for the CH_3I trapping experiments reported in a previous quarterly report, for the same catalyst. During the C_2H_5I trapping experiments the CO stream was diverted through a saturator containing C_2H_5I which was kept in a Dewar flask. The temperature of the C_2H_5I was adjusted to maintain a 1% by volume of C_2H_5I concentration in the gas phase. Effluent gas analysis was carried out on-line using a Perkin-Elmer Sigma 300 GC, fitted with TC and Fl detectors and a 12 m. SP-1700 column maintained at 343 K, as before. As with CH_3I, C_2H_5I also produced significant changes in the product distribution of the F-T reaction. The most striking observations made during the C_2H_5I trapping experiments are summarized briefly.

35318 **(IS-T—1199) NMR studies of catalysts: Phosphorous-31 and vanadium-51 in vanadium-phosphorous-oxygen selective oxidation catalysts and the selective averaging of the second order quadrupolar interaction in aluminosilicates.** Walker, R.D. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010931.

Results of EPR and ^{31}P and ^{51}V NMR experiments on vanadium-phosphorous-oxygen catalysts revealed the presence of V(III) as well as the expected V(IV) and V(V). Preparations known to be highly oxidized,l such as β-$VOPO_4$ and B phase catalyst with P/V = 0.9, yielded NMR spectra showing only small effects of unpaired electron spin, and the EPR spin count indicated a correspondingly low concentration of V(IV). On the other hand, catalysts known to be highly reduced, such as butane-treated $(VO)_2P_2O_7$ and B phase catalysts with P/V = 1.0, 1.1, gave NMR spectra with strong effects of unpaired electron spin but low EPR spin counts. Since EPR will routinely detect V(IV) but not V(III) (and no unpaired electron spins are associated with V(V)), the strong paramagnetic effects observed in the reduced catalysts must result from V(III). The catalysts examined included the model compounds β-$VOPO_4$ and $(VO)_2P_2O_7$ before and after butane and butene treatment, precatalysts (P/V = 0.9, 1.0, 1.1) and B phase catalysts (P/V = 0.9, 1.0, 1.1) before and after butane treatment. The line broadening effects of the second-order quadrupolar interaction cause loss of resolution in the NMR spectra of interesting systems, such as ^{27}Al in zeolites. A multiple pulse sequence proposed to selectively average the effects of the second-order quadrupolar interaction was investigated.

35319 **(IS-T—1255) Picosecond laser studies of V-T processes in gases and electronic excitation transport in disordered systems.** Hedstrom, J.F. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 325p. NTIS, PC A14/MF A01; 1; GPO Dep. File Number DE87010923.

SVL fluorescence spectroscopy was used to study intramolecular energy transfer from the 0^0 level of aniline induced by collisions with CO_2. Time-correlated photon counting was used to measure concentration dependent fluorescence depolarization for rhodamine 6G in glycerol. Fluorescence decays from these viscous solutions provide data for analyzing the three-dimensional, three-body excitation transport theory developed by Gochanour, Andersen and Fayer for disordered systems. The two-dimensional, two-body excitation theory developed by Loring and Fayer was also examined using time-resolved fluorescence depolarization techniques. The samples, made up of submonolayers of rhodamine 3B adsorbed onto optically flat fused silica yield fluorescence profiles which agree well with profiles developed from the theory for reduced surface coverages up to ~0.4. At higher coverages, excitation trapping by rhodamine 3B aggregates truncates the depolarization process, yielding apparent reduced coverages which are appreciably lower than the true coverages.

35320 **(IS-T—1259) Coherent electronic energy transfer and nonlinear polariton effects in anthracene-doped naphthalene crystals.** Connolly, M.A. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010922.

The electronic energy transfer in strain-free mounted anthracene-doped naphthalene single crystals at frequencies near that of the (0,0) a-exciton in naphthalene was probed using sensitized resonant two-photon fluorescence excitation (TPE) and second harmonic generation (SHG) spectroscopies. The naphthalene-to-anthracene TPE intensity ratios were 1.2 and 1.6, for excitation of the zero-phonon transition at 1.6 and 20°K, respectively. Energy transfer for the pure and the anthracene-doped naphthalene systems was in the capture limited regime, that is, the trapping event occurs on a timescale long compared to the migration of the excitation to the trap. The polariton trapping event is discussed in terms of scattering off a trap with subsequent trapping (i.e., capture) and scattering off a trap without subsequent trapping (i.e., trap scattering). The branching ratio for the trap scattering frequency to the capture frequency, was calculated to be 5 to 1 for the doped system. The branching ratio was used to determine the individual scattering frequencies. The lower bound for the coherent trapping or trap scattering radius was 100 A. Thermal broadening and temperature dependences of TPE and SHG signal intensities are discussed in terms of the polariton fusion model. The first report of a longitudinal exciton in a doped organic molecular system also is reported.

35321 **(IS-T—1278) X-ray diffraction studies of bismuth-doped lead dioxide electrodes, of the radiation-damaged benzene chromium tricarbonyl crystal structure, and of selected organometallic compounds.** Kim, Sangsoo. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 180p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87010934.

X-ray powder diffraction patterns of lead dioxide electrodes electrodeposited with Bi, As, or Tl were taken and analyzed via the Rietveld procedure. The diffraction patterns of the electrodeposited electrodes show strong preferred orientation and particle size broadening of the diffraction peaks. Variations of these two properties as a function of [Bi]/[Pb] seem to be closely correlated to the electrochemical oxidizing catalytic activities of the electrodes. A study of x-ray radiation damage on a molecular single crystal, $Cr(CO)_3(C_6H_6)$, was carried out. Apparently, the severe irradiation caused gradual loss of crystalline character, probably by weakening intermolecular packing forces. Little changes in intramolecular geometry were noticed. The crystal structure determination of $[HB(pz)_3](CO)_2W$-[eta^2-CH(SMe)].CF_3SO_3, 1, confirmed the presence of the eta^2-thiocarbene ligand, bonded to the tungsten through both the C and S atoms. The Patterson superposition method was successfully applied to the determination of the crystal structures of $LiMo_3O_{10}$ and $4PPh_4.[O_2MoS_2FeS_2].6H_2O$. Ripples in Fourier maps due to series termination errors can aid structural solutions via Patterson superposition method.

35322 **(IS-T—1289) Catalytic reactor and organometallic model studies of the mechanism of thiophene hydrodesulfurization.** Sauer, N.N. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010924.

The reactivity of transition metal complexes of thiophene (Th) and 2,3- and 2,5-dihydrothiophenes (DHT) and catalytic reactor studies of thiophene and the dihydrothiophenes have been used to examine the mechanism for the hydrodesulfurization (HDS) of thiophene. Catalytic deuterium exchange of thiophene over HDS catalysts was modeled by the reaction of π-thiophene complexes, $CpRu(Th)^+$ (where Th=thiophene, 2, or 3 methylthiophene or 2,5-dimethylthiophene) in CD_3OD with OH^-. Reactor studies with thiophene and 2,3- and 2,5-DHT were done at 300° and 400°C over a Re/γ-Al_2O_3 HDS catalyst. Deuterodesulfurization studies established that 2,5-DHT directly eliminates butadiene while butadiene formation from 2,3-DHT must involve several surface steps over the catalyst. Several reactions of the dihydrothiophenes over HDS catalysts were modeled using transition metal complexes of 2,3 and 2,5-DHT. The S-bound 2,3-DHT in $W(CO)_5$(2,3-DHT) is converted to tetrohydrothiophene upon treatment with HCl. When $Fe_2(CO)_9$ is reacted in THF with 2,3-DHT though, no isolable

$Fe(CO)_4$(2,3-DHT) complex is obtained, but small amounts of 2,5-DHT are observed by ^1H NMR. Reaction of 2,5-DHT with $Fe_3(CO)_9$ does result in the formation of $Fe(CO)_4$(2,5-DHT), which readily eliminates butadiene.

35323 (IS-T—1307) Model vanadium-phosphorus-oxygen catalysts for the selective oxidation of C_4 hydrocarbons to maleic anhydride. Moser, T.P. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010935.

Two model vanadium-phosphorus-oxygen catalysts, β-$VOPO_4$ and $(VO)_2P_2O_7$, were investigated for the selective oxidation of C_4 hydrocarbons to maleic anhydride. In situ laser Raman spectroscopy was used. Complementary techniques including x-ray powder diffraction and x-ray photoelectron spectroscopy were used for characterization of the fresh and used catalytic materials. The direct observation of phase stability and the participation of lattice oxygen during catalysis was possible using the in situ Raman technique. In particular, β-$VOPO_4$ and $(VO)_2P_2O_7$ demonstrated bulk structural integrity during n-butane oxidation. The relatively greater reducing capacity of 1-butene induced the β-$VOPO_4$ to $(VO)_2P_2O_7$ phase transformation. Direct structural identification of catalytically active centers for paraffin and olefin oxidation were investigated using an ^{18}O-enriched β-$VOPO_4$ phase catalyst. Active sites responsible for complete combustion (Site I) and selective oxidation (Site II) were identified. The selective route for 1-butene oxidation involved predominantly Site II centers, while Site I centers were associated with complete combustion. In contrast, n-butane oxidation required the highly active Site I centers for initial activation and for the formation of an intermediate containing two oxygen atoms. Raman band assignments indicated these oxygen sites were associated with PO_4 units in the β-$VOPO_4$ lattice. Maleic anhydride conversion was particularly sensitive to the catalytic phase present. Significant combustion activity was observed when maleic anhydride was fed directly to an integral flow reactor charged with model catalysts. The combustion activity was least for $(VO)_2P_2O_7$, nominally a V(IV) phase. The β-$VOPO_4$ catalyst, nominally a V(V) phase, resulted in increased conversions of maleic anhydride.

35324 (IS-T—1313) Vanadium-phosphorus-oxygen industrial catalysts for C_4 hydrocarbon selective oxidation to maleic anhydride. Wenig, R.W. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010937.

The selective oxidation of n-butane to maleic anhydride by vanadium-phosphorus-oxygen (V-P-O) industrial catalysts varying in P-to-V ratio has been studied in a fixed bed integral reactor system. Catalyst characterization studies including x-ray diffraction, laser Raman spectroscopy, infrared spectroscopy, x-ray photoelectron spectroscopy, scanning electron microscopy, x-ray energy dispersive spectroscopy, and BET surface area measurements were used. A strong effect of P-to-V synthesis ratio on catalyst structure, catalyst morphology, vanadium oxidation state, and reactivity in n-butane selective oxidation was observed. A slight "excess" of catalyst phosphorus (P/V = 1.1 catalyst) was found to stabilize an active and selective $(VO)_2P_2O_7$ phase. The mechanism of n-butane selective oxidation to maleic anhydride was studied by in situ infrared spectroscopy using n-butane, 1-butene, 1,3-butadiene, crotyl alcohol, maleic acid, crotonic acid, and maleic anhydride feeds. During paraffin selective oxidation, highly reactive olefin species and maleic acid were observed on the surfaces of V-P-O catalysts. Further evidence in support of conjugated or possibly strained olefin and maleic acid reaction intermediates in n-butane and 1-butene partial oxidation to maleic anhydride was gathered.

35325 (LBL—23329) Energetic and structural relationships involved in the intercalation of graphite by fluorospecies. Kourtakis, K. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 171p. NTIS, PC A08/MF A01; 1; GPO Dep. File Number DE87010769.

This thesis is divided into three sections. The first section (Chapter 2) deals with some thermodynamic considerations of the strengths of fluoracids and bases. The second (Chapter 3) consists mainly of studies on the new interhalogen fluorospecies ClF_2. Finally, fluoroborate and fluorophosphate intercalation salts of graphite are discussed in Chapters 4-6 and a general overview of their chemistry presented. The last chapters have tried to establish a link between graphite intercalation and the thermochemistry of the intercalating fluorospecies.

35326 (LBL—23388) Structure analysis and photochemistry of adsorbates on platinum and palladium surfaces. Grassian, V.H. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 223p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010694.

The vibrational spectra of benzene and toluene adsorbed on Pd(111) indicates at 180K these molecules weakly bond to the surface. The adsorption of benzene and toluene on Pt(111) is much stronger as indicated by large frequency shifts from gas phase values. Pyridine adsorption on both Pt(111) and Pd(111) was studied as a function of temperature. At room temperature pyridine decomposes on the surface to form an α-pyridyl fragment (NC_5H_4) on Pt(111), whereas the molecule remains intact on Pd(111). The electron energy loss spectra of pyridine adsorbed on these surfaces is compared to the ir spectra of two osmium cluster compounds: $Os_3(CO)_{11}(NC_5H_5)$, a pyridine complex, and $HOs_3(CO)_{10}(NC_5H_4)$, a pyridyl complex. The stronger interaction of these molecules to the platinum surface is a consequence of the stronger bonding of the 5d orbitals as compared to the 4d orbitals. The uv photochemistry of 2-butene and 1,2-dichloroethene when adsorbed on Pt and Pd surfaces was also studied.

35327 (NP—7770100) Thermodynamic potential for the methanol/lithium bromide system. Bunte, H.-J. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 19 Jul 1984. 159p. (In German). NTIS (US Sales Only), PC A08. File Number DE87770100.

A thermodynamic potential with free enthalpy as the functional variable is established for the methanol/lithium bromide system. The thermodynamic potential of pure methanol is an important factor, owing to the fact that the gas phase of the system consists of pure methanol. The mechanisms of interaction between temperature, pressure, and free enthalpy of methanol are modelled via separate functional approaches for the gaseous and liquid phase. The model function for the liquid phase is characterized in that it contains an independent part describing the temperature dependence of free enthalpy upon saturation. The model function of the gaseous phase is orientated along the quasi-chemical theory.

35328 Hard-sphere theory for correlation of tracer diffusion of gases and liquids in alkanes. Matthews, M.A.; Akgerman, A. (Chemical Engineering Department, Texas A&M University, College Station, Texas 77843). *Journal of Chemical Physics;* **87**: No. 4, 2285-2291(15 Aug 1987).

The rough hard-sphere (RHS) theory for transport properties has substantially improved understanding of diffusion, viscosity, and thermal conductivity. At present, however, quantitative predictions for polyatomic species are hampered by uncertainties in assigning the hard-sphere diameter and the roughness factor, and by lack of molecular dynamics calculations. Because the qualitative features of the theory have proven correct for a variety of chemical systems, methods have been proposed for using rough hard-sphere theory even when the exact parameters needed to apply the theory are unknown. One such approach is examined for tracer diffusion in alkane solvents for solutes ranging in size from hydrogen to hexadecane. Useful relations are shown which are simple, yet entirely consistent with hard-sphere theory. The approach circumvents the difficulties in assigning roughness factor, diameter, and molecular dynamics results.

35329 Kinetics of the activated dissociative adsorption of methane on the low index planes of nickel single crystal surfaces. Beebe T.P. Jr.; Goodman, D.W.; Kay, B.D.; Yates J.T. Jr. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **87**: No. 4, 2305-2315(15 Aug 1987).

We have measured the kinetics of the methane decomposition reaction on Ni(111), Ni(100), and Ni(110) single crystal surfaces under the high incident flux conditions of 1 Torr methane. We find for these processes apparent activation energies of 12.6,

6.4, and 13.3 kcal mol^{-1}, respectively. Initial methane sticking coefficients at 500 K vary with the Ni surface, but are all -10^{-8} to 10^{-7}. The Ni(110) surface is the most active, followed by Ni(100) and Ni(111). A large (— factor of 20) kinetic isotope effect is seen for CH_4 vs CD_4 on the Ni(100) surface, whereas none is seen on the Ni(110) surface. A comparison is made between measured thermal sticking coefficients and those calculated from the results of recent molecular beam experiments of CH_4 on Ni(111) and Ni(100) surfaces. Agreement of our results with the Ni(100) beam results is poor, whereas agreement with the Ni(111) beam results is very good. A comparison is also made between our results and rates of the catalytic steam reforming reaction of methane.

35330 Intermolecular influences on M-M multiple bonds from thin-film UPS studies of group VI $M_2(O_2CCH_3)_4$ complexes. Lichtenberger, D.L.; Kristofzski, J.G. (Univ. of Arizona, Tucson). *Journal of the American Chemical Society;* **109**: No. 11, 3458-3459(27 May 1987).

Dimetal tetracarboxylate complexes have provided a rich arena for study of metal-metal bonding since the presence of σ-, π-, and δ-orbital symmetry interactions was first explained in 1964. The title compounds have proven particularly fruitful for investigating these interactions because the volatility of these compounds makes them suitable for gas-phase photoelectron studies, thus allowing detailed experimental examination of the theoretical principles of bonding. Development of the basic bonding description for these complexes has been accompanied by numerous studies of the effects of bridging ligands and axial interactions on the metal-metal bond strength and bond length. As one step to examining the electronic effects of axial occupation on the metal-metal bond, they have obtained the photoelectron spectra of thin films of anhydrous group VI tetraacetates. In these thin films the axial positions of the metal-metal bonds are occupied by neighboring molecules. With appropriate preparation of these films in ultrahigh vacuum conditions, they are able to obtain spectra which exhibit only slight broadening as compared to the gas-phase spectra, indicating that each molecule contributing to the observation is in a similar electronic environment. The axial positions of the metal-metal bonds are most likely occupied by the oxygen atoms of the neighboring complexes, as found in the single-crystal structures.

35331 Heterogeneous sonocatalysis with nickel powder. Suslick, K.S.; Casadonte, D.J. (Univ. of Illinois, Urbana-Champaign). *Journal of the American Chemical Society;* **109**: No. 11, 3459-3461(27 May 1987). Contract AC02-76ER01198.

The authors have discovered that ultrasonic irradiation of Ni powder increases its activity as a hydrogenation catalyst by $>10^5$. In order to probe the origin of this dramatic enhancement, the surface composition has been examined. They find that ultrasonic irradiation of Ni powder causes remarkable changes in particle aggregation, surface morphology, and thickness of the surface oxide coating.

35332 Reversible stereospecific extrusion of ethylene from a 1,2-diosmacyclobutane. Determination of stereochemistry by liquid-crystal NMR. Hembre, R.T.; Scott, C.P.; Norton, J.R. (Colorado State Univ., Fort Collins). *Journal of the American Chemical Society;* **109**: No. 11, 3468-3470(27 May 1987). Contract FG02-84ER13299.

The authors now report that the loss of ethylene from (μ-1,2-ethanediyl)octacarbonyldiosmium (1) is stereospecific. In a reaction analogous to the desorption of an olefin from a metal surface, undergoes facile ethylene loss. As 1 is related to cyclobutane by the isolobal analogy between $Os(CO)_4$ and CH_2, the loss of ethylene from 1 can be compared to the fragmentation of cyclobutane into two ethylenes - a classic example of a reaction forbidden by orbital symmetry as a concerted process. One would, therefore, expect the loss of ethylene from 1 to be forbidden as a concerted process and to occur by a diradical mechanism leading to loss of stereochemistry.

35333 Dimerization energy of borane. Page, M.; Adams, G.F.; Binkley, J.S.; Melius, C.F. (Naval Research Lab., Washington, DC). *Journal of Physical Chemistry;* **91**: No. 11, 2675-2678(21 May 1987).

Ab initio quantum chemical calculations are presented for the energy dimerization of the borane molecule ($2BH_3 \rightarrow B_2H_6$). The calculations are superior to previous theoretical treatments both in the level of treatment of electron correlation and in the one-electron basis set. The effects of improving the basis set without electron correlation and improving the treatment of electron correlation and the coupling between these improvements all reveal corrections which increase the magnitude of the dimerization energy relative to previous theoretical predictions. By calculating the correction for zero-point vibrational differences and estimating the temperature dependence, the authors predict the enthalpy of dimerization of borane at 298 K to be -39.6 kcal/mol. A new value (2.7 kcal/mol) for the standard heat of formation of diborane is presented. This value is determined from the calculated atomization energy of diborane.

35334 Semiclassical determination of eigenvalues in nonbending ozone. Knudson, S.K.; Noid, D.W.; Koszykowski, M.L. (College of William and Mary, Williamsburg, VA). *Journal of Physical Chemistry;* **91**: No. 11, 2763-2768(21 May 1987). Contract AC05-84OR21400.

The authors have determined all the vibrational eigenvalues below 16,000 cm^{-1} for a two-mode ozone potential, using the surface of section semiclassical method combined with interpolation to integer quantum numbers; with this approach more than 80 eigenvalues were determined from only 21 arbitrary classical trajectories. The ozone potential surface is represented by a 20 x 20 grid of points obtained at the 6-31G* level with electron correlation included via a fourth-order Moeller-Plesset perturbation calculation. The forces needed to integrate the classical equations of motion are found by using a two-dimensional spline fit to the potential points. Classical trajectories are then generated; each gives tow surfaces of section from which classical actions and noninteger quantum numbers are extracted. A two-dimensional interpolation of the energy surface expressed as a function of these quantum numbers then rapidly locates the eigenvalues. These semiclassical eigenvalues generally agree with variationally determined quantum eigenvalues to within a few wavenumbers, for the first five states of each parity; this agreement holds even for states with eigenvalues corresponding to trajectories located in a classical resonance region.

35335 Assignment of the low-frequency modes in trans-stilbene. Evidence for planarity in the isolated molecule. Spangler, L.H.; van Zee, R.; Zwier, T.S. (Los Alamos National Lab., NM). *Journal of Physical Chemistry;* **91**: No. 11, 2782-2786(21 May 1987).

The authors report the assignment of low-frequency vibrations in the excitation spectrum and several dispersed fluorescence spectra of trans-stilbene. All transitions of significant intensity in the first 400 cm^{-1} of the excitation spectrum and the first 200 cm^{-1} of the dispersed fluorescence spectra are assigned with the use of only three modes, nu$_{36}$ (C/sub e/-Ph out-of-plane bend), nu$_{37}$ (C/sub e/-Ph torsion), and nu$_{25}$ (C/sub e/-C/sub e/-Ph in-plane bend). Only even quanta transitions involving nu$_{36}$ and nu$_{37}$ are observed, indicating that these modes are symmetry forbidden and that the molecule possesses an inversion center of symmetry. The rho-methyl-trans-stilbene spectrum also shows only even quanta transitions of nu$_{37}$ providing evidence that this molecule and, by analogy, trans-stilbene are both planar.

35336 P(4S/sub u/) + N_3(2II/sub g/) reaction: chemical generation of a new metastable state of PN. Henshaw, T.L.; MacDonald, M.A.; Stedman, D.H.; Coombe, R.D. (Univ. of Denver, CO). *Journal of Physical Chemistry;* **91**: No. 11, 2838-2842(21 May 1987).

The kinetics and spectroscopy of the chemiluminescent reaction between P(4S/sub u/) atoms and N_3(2II/sub g/) radicals were studied with a discharge-flow apparatus. The chemiluminescence exhibited three band systems, which were identified as PN ($A^1\Pi \rightarrow X^1\Sigma^+$), PF($B^3\Pi \rightarrow X^3\Sigma^-$), and a previously unobserved system in PN. From the spectrum of the new system, molecular constants of the excited state were found to be T/sub e/ = 25,863 +/- 16 cm^{-1} omega/sub e/" = 957 +/- 8 cm^{-1}, and omega/sub e/X/sub e/" = 18 +/- 2 cm^{-1}. This excited state appears to be significantly Franck-Condon shifted from the ground state, with 0,3 being the

most intense band of the spectrum. From comparison of this system with the analogous N(⁴S/sub u/) + N_3(²II/sub g/) reaction, the new excited state of PN is expected to be a triplet metastable, either a^3II or $a'^3\Sigma^+$. Analysis of the time behavior of the removal of P atoms from the system indicated a rate constant of (4.7 +/- 0.4) x 10^{-11} cm^3 s^{-1} for the P + N_3 reaction. The lifetime of the excited metastable state of PN is greater than 4 ms.

35337 **Rare earth oxide catalyzed oxidation of rhenium to ReO_4p and ReO_3^- as observed by negative surface ionization mass spectrometry.** Delmore, J.E. (EG & G Idaho, Inc., Idaho Falls). *Journal of Physical Chemistry;* **91**: No. 11, 2883-2886(21 May 1987).

A surface ionization mass spectrometer was used to observe the in situ formation of ReO_4^- and ReO_3^- gas-phase ions resulting from the rare earth oxide catalyzed reaction of water with metallic rhenium. Water was found to be 6-10-fold more efficient than oxygen as an oxidizer at temperatures around 1100°C. Normal, oxygen-18 enriched, and deuteriated water were used to elucidate the oxidation mechanism. The results were consistent with a mechanism whereby the rare earth oxide goes through a stoichiometric cycle, with the highly stoichiometric oxide functioning as a strong oxidizer and the oxidizing potential being reduced as the rare earth moves into a mixed valency state with reduced oxygen content. The oxygen stoichiometry (and the oxidative potential) is then restored by reaction with water. The oxygen of the water is slowly equilibrated with the original oxygen of the rare earth oxide, with the variations between the rare earths being consistent with known rare earth mixed valency chemistry. The highly stoichiometric oxide readily oxidizes rhenium with high efficiency. The results of this work suggest that both positive and negative surface ionization mass spectromery should be explored as tools for the in situ study of surface catalyzed gas-solid reactions. Few techniques are capable of monitoring the dynamics of solid-state chemical reactions at these temperatures, and surface ionization appears to offer some hope for elucidating at least some reactions at elevated temperatures.

35338 **Unimolecular dissociation of cyclohexene at extremely high temperatures: behavior of the energy-transfer collision efficiency.** Kiefer, J.H.; Shah, J.N. (Univ. of Illinois, Chicago). *Journal of Physical Chemistry;* **91**: No. 11, 3024-3030(21 May 1987). Contract AC02-78ER04759.

The dissociation of cyclehexene has been observed in shock waves with the laser schlieren and pulsed laser flash absorption techniques over 1200-2000 K and 110-550 Torr, using 2% and 4% cyclohexene in krypton and 0.2% cyclohexene in argon. The inverse Diels-Alder molecular elimination to 1,3-butadiene and ethylene is clearly the dominant dissociation channel under all conditions. Rate constants derived for this reaction have a high precision, with rms deviations of only a few percent. Unimolecular falloff, although slight at the lowest temperatures, is clearly discernible for all temperatures. A simple RRKM calculation, using a nonspecific vibration model transition state, is fit to the measured rate constants, giving log k/sub infinity/ = 15.57 - 65.7 (kcal/mol)/2.303RT with a barrier of 61.9 kcal/mol. These RRKM calculations were performed with the energy-transfer collision efficiency derived from both fixed <ΔE>/sub down/ and <ΔE>/sub all/. A good fit is achieved with either below 1500 K, but above this a fixed <ΔE>/sub down/ gives rates which are much too small, and this deficiency cannot be compensated by other changes, whereas a fixed <ΔE>/sub all/ provides quite satisfactory agreement with the measurements for all conditions. This situation is similar to that indicated by other large molecule dissociations at extreme temperatures.

35339 **Solvent properties of supercritical Xe and SF_6.** Smith, R.D.; Frye, S.L.; Yonker, C.R.; Gale, R.W. (Battelle Pacific Northwest Lab., Richland, WA). *Journal of Physical Chemistry;* **91**: No. 11, 3059-3062(21 May 1987). Contract AC06-76RL01830.

The UV absorption solvatochromic shift for a probe solute (2-nitroanisole) has been used to explore the solvent properties of supercritical SF_6, Xe, and C_2H_6. The π^* polarity/polarizability scale established by Kamlet, Taft, and co-workers has been used to compare solvent properties with liquids and previously studied supercritical fluids (CO_2 and NH_3). The π^* measurements for Xe show that it is a less polar/polarizable solvent then CO_2 at similar reduced densities. SF_6 was found to have lower π^* parameters than Xe, although it has a greater polarizability. A change in the dependence of π^* upon density was observed at reduced densities of 0.70 +/- 0.15 for all fluids studied.

35340 **Examination of some effects of NO_2 rotation in nitrobenzene.** Politzer, P.; Lane, P.; Jayasuriya, K.; Domelsmith, L.N. (Univ. of New Orleans, LA). *Journal of the American Chemical Society;* **109**: No. 7, 1899-1901(1 Apr 1987).

A computational analysis has been made of some of the effects of rotating the NO_2 group of nitrobenzene by 90° from its equilibrium position in the plane of the aromatic ring. An ab initio SCF approach was used to compute the optimized structures and molecular electrostatic potentials of these two forms of nitrobenzene. A comparison of the calculated structures indicates that there is only a very small degree of conjugation between the nitro group and the aromatic ring in the equilibrium form of the molecule. Chemical consequences of NO_2 rotation are expected to include a decreased reactivity toward nucleophiles, but a slightly greater susceptibility to electrophilic attack.

35341 **One-electron reduction of dihexadecyl phosphate vesicle bound viologens by dithionite ion.** Thompson, D.H.P.; Barrette, W.C. Jr.; Hurst, J.K. (Oregon Graduate Center, Beaverton). *Journal of the American Chemical Society;* **109**: No. 7, 2003-2009(1 Apr 1987). Contract AC06-83ER13111.

N-Methyl-N'-alkyl-4,4'-bipyridinium (C/sub n/MV^{2+}) ions bound to dihexadecyl phosphate vesicles are rapidly reduced to radical cations by $S_2O_4^{2-}$ in weakly alkaline solutions. For the short-chain viologens investigated (n = 1, 6, 8), the reaction obeys the rate law d[C/sub n/MV^+]/dt = k[C/sub n/MV^{2+}][$S_2O_4^{2-}$]/sup 1/2/. The measured rate constants were identical for preparations in which viologen was added to preformed vesicles and in which vesicles were formed in the presence of viologen, although in the latter systems 10-30% of the viologen was inaccessible to the reductant. For longer chain C/sub n/MV^{2+} (n = 12, 14, 16, 18, 20), viologen radical formation was biphasic when binding was constrained to the external aqueous-vesicle interface, but it was triphasic when viologen was bound at both interfaces. Where determined, each step was first order in C/sub n/MV^{2+} and half order in $S_2O_4^{2-}$; viologen radical yields were identical in vesicles prepared by either method. The results are interpreted to indicate the simultaneous existence of multiple binding domains for long-chain viologens within the vesicles. Possible structures and relationships to transmembrane redox pathways are briefly discussed.

35342 **Anisotropy of intermolecular interactions, band electronic structure, and electrical properties of β-$(ET)_2AuCl_2$.** Emge, T.J.; Wang, H.H.; Bowman, M.K.; Pipan, C.M.; Carlson, K.D.; Beno, M.A.; Hall, L.N.; Anderson, B.A.; Williams, J.M.; Whangbo, M.H. (Argonne National Lab., IL). *Journal of the American Chemical Society;* **109**: No. 7, 2016-2022(1 Apr 1987). Contract W-31-109-ENG-38;FG05-86ER45259.

A new organic salt, β-$(ET)_2AuCl_2$, was synthesized, and its structure and physical properties were determined. Here ET refers to bis(ethylenedithio)tetrathiafulvalene (BEDT-TTF or ET). β-$(ET)_2AuCl_2$ is isostructural with β-$(ET)_2ICl_2$ and contains the shortest anion, $AuCl_2^-$, among the β-$(ET)_2X$ salts with linear anions, X^-, known so far. Crystal data for β-$(ET)_2AuCl_2$ are as follows: triclinic, P anti 1, 298 K/120 K, a = 6.651 (1)/6.627 (2) A, b = 9.761 (2)/9.595 (3) A, c = 12.734 (3)/12.662 (4) A, α = 86.12 (2)/85.15 (2)°, β = 100.70 (2)/101.40 (2)°, γ = 99.41 (2)/98.24 (2)°, and V/sub c/ = 800.7 (4)/779.8 (5) A^3. The electrical conductivities of type I β-$(ET)_2X$ salts (i.e., those with short anions X^- = $AuCl_2^-$, ICl_2^-) measured by the four-probe technique show that they are semiconductors with thermal activation energy of 0.10 eV. The valence band (i.e., the highest occupied band) of β-$(ET)_2AuCl_2$, which is half-filled, is calculated to be one-dimensional in character as in the case of β-$(ET)_2ICl_2$. ESR data of β-$(ET)_2AuCl_2$ reveal the presence of a phase transition at ~ 33 K, which is somewhat higher than the corresponding temperature (22

K) of β-$(ET)_2ICl_2$. The ET molecule pairs of type I β-$(ET)_2X$ salts are significantly more dimerized than those of type II β-$(ET)_2X$ salts (i.e., those with long anions $X^- = IBr_2^-$, AuI_2^-, I_3^-).

35343 Stereochemical consequences of thermal fluorine-for-chlorine atomic substitution with 2(S)-(+)-chloropropionyl chloride. Firouzbakht, M.L.; Ferrieri, R.A.; Wolf, A.P. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **109**: No. 7, 2213-2214(1 Apr 1987). Contract AC02-76CH00016;FG02-84ER13231.

In the present report, the stereochemical consequences from thermalized ^{18}F atom substitution on the chiral center of 2(S)-(+)-chloropropionyl chloride were investigated in the gas phase. The purpose of this work was not only to provide evidence in support of a dual approach channel for substitution, but to qualitatively establish the energy requirements of each channel. This was accomplished through a comparison of results obtained in both nonthermal and thermalized ^{18}F atom substitutions.

35344 Deconvolution of ion-exchange isotherms. Triay, I.R.; Rundberg, R.S. (Los Alamos National Lab., NM). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The behavior of monovalent ion-exchange isotherms has been mathematically described using a Fredholm Integral Equation of the First Kind (IFK) involving a selectivity coefficient distribution function which emphasizes the heterogeneity of the ion-exchange process. A regularization technique has been applied to deconvolute the IFK, yielding the selectivity coefficient distributions from the ion-exchange isotherms. Regularization has successfully recovered normal and log-normal unimodal and bimodal distributions from computer generated isotherms with up to 10% indeterminate errors. This method has also been used to deconvolute ion-exchange isotherms obtained from the literature describing the exchange of monovalent cations into the Linde Na-X and Na-Y synthetic faujasites.

35345 The influence of equilibrium chemical reactions on vapor-liquid phase diagrams. Barbosa, D.; Doherty, M.F. New York, NY; American Institute of Chemical Engineers (1986). 58p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Phase diagrams for simultaneous chemical reaction and phase equilibrium are presented for ideal and non-ideal systems. It is shown that reactive-azeotropes can occur for ideal mixtures. The conditions for formation of reactive-azeotropes in constant volatility systems are derived. These conditions show that for such systems reactive-azeotropes can occur only when the volatiles of the reactants are either all higher or all lower than the volatilities of the products.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 35021, 35177, 35428, 35429, 35763

35346 (AD-A—178699/4/XAB) Chemistry and electrochemistry of molybdenum plating from molten salts. White, S.H.; Twardoch, U.M. (EIC Labs., Inc., Norwood, MA (USA)). 18 Apr 1986. 10p. NTIS, PC A02/MF A01.

Pub. in Proceedings of the International Workshop on High-Temperature Molten Salt Batteries, C12-C19(18 Apr 1986).

This paper is concerned with the synergism between solution chemistry and the electrode chemistry in electroplating molybdenum. Before presenting the results from some basic studies, this specific area of materials processing is placed in the context of electrolytic methods of materials fabrication for use in corrosive environments at elevated temperatures and high potentials. EIC has ongoing programs which are concerned with the development of electroplating refractory metals, in particular these in VIA, chromium, molybdenum, and tungsten from electrolyte operating below 500 C. These metals are of particular interest in view of their high melting points, hardness, and corrosion resistance, particularly at higher temperatures in oxygen-free, or reducing environments and/or at high potentials which make them strong candidates as construction materials in new technologies. The ability to electroplate and electroform these metals and their alloys is an important aspect of their successful application for corrosion and corrosion protection. Electroplating of metals from molten salts has been less successful because the process requires a coherent deposit of metal with specified properties. This has restricted applications to aluminum and some transition metals. Electrolyte baths based upon molten alkali fluoride as solvent have been employed successfully with refractory metals. The mean valencies of the refractory metals ions in solution, their reduction pathway and the temperatures at which the processes would need to be operated are summarized.

4005 Photochemistry

REFER ALSO TO CITATION(S) 35326, 35335, 35336, 35338

35347 Internal state distributions of CO from HNCO photodissociation. Spiglanin, T.A.; Perry, R.A.; Chandler, D.W. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **87**: No. 3, 1568-1576(1 Aug 1987).

The internal state distributions of CO produced by photodissociation of HNCO at 1930 (230.1 nm) and at 10 200 cm^{-1} (193.3 nm) in excess of the dissociation energy are determined from multiphoton ionization spectra of the CO fragment measured under collision-free conditions. The rotational state distribution of the CO produced at the lower photolysis energy is characterized by a temperature of (491 +- 23) K. The rotational state distribution of CO produced by photodissociation at the higher photon energy in not well characterized by a temperature. This latter distribution has maximum population near $J = 37$, extends beyond $J = 65$, and accounts for —20% of the available energy in excess of that necessary to rupture the HN—CO bond. An impulsive dissociation model assuming that dissociation occurs from an excited HNCO complex containing a nonlinear N—C—O configuration accounts for the average CO rotational excitation while phase-space theory does not agree with the observed distributions. Fitting a semiclassical model to the data using a logically constructed potential energy surface and a ground-state-dependent function provides a useful parametrization for the impulsive dissociation. Although not absolute, this analysis suggests that the dissociation occurs directly on a repulsive excited state potential energy surface.

35348 Rotational state distributions of NH(a ^1m) from HNCO photodissociation. Spiglanin, T.A.; Chandler, D.W. (Combustion Research Facility, Sandia National Laboratories, Livermore, California 94550). *Journal of Chemical Physics;* **87**: No. 3, 1577-1581(1 Aug 1987).

We have examined the photofragmentation HNCO→NH(a $^1\Delta$)+CO using radiation at wavelengths shorter than 230 nm. Nascent NH(a $^1\Delta$) shows relatively little rotational excitation, accounting for less than 12% of the energy in excess of the dissociation energy. The rotational state distributions evidence less population in high rotational states than predicted by statistical theories but more than expected on the basis of a simple impulsive dissociation. A semiclassical impulsive model that describes photoproduct rotation as developing during fragmentation successfully describes the rotational state distributions of NH(a $^1\Delta$) produced by HNCO photodissociation over a wide range of wavelengths. The success of this model in describing the NH rotational state distributions and previously measured CO rotational state distributions suggests that the excited state potential energy surface may be repulsive with minima in HNC and NCO bond angles each near 120°.

35349 Solvent tuning of the excited-state properties of (2,2′-bipyridine)tetracyanoferrate(II): direct observation of a metal-to-ligand charge-transfer excited state of iron(II). Winkler, J.R.; Creutz, C.; Sutin, N. (Brookhaven National Lab., Upton, NY). *Journal of the American Chemical Society;* **109**: No. 11, 3470-3471(27 May 1987). Contract AC02-76CH00016.

In contrast to $Ru(bpy)_3^{2+}$ and $Os(bpy)_3^{2+}$ (bpy = 2,2'-bipyridine) the lowest excited state of $Fe(bpy)_3^{2+}$ is LF (ligand field) rather than MLCT (metal-to-ligand charge transfer) in character. Replacement of a bpy by two stronger field CN^- ligands to give $Fe(bpy)_2(CN)_2$ does not alter this ordering. Here the authors report observations that show that in water this ordering is retained for $Fe(bpy)(CN)_4^{2-}$ even with its stronger ligand field but that the extraordinary solvent sensitivity of this complex can be used to access the MLCT state: the MLCT state is observed in the weak acceptor solvent acetone.

35350 **Formation and characterization of microcrystalline semiconductor particles on bilayer lipid membranes.** Baral, S.; Zhao, X.K.; Rolandi, R.; Fendler, J.H. (Syracuse Univ., NY). *Journal of Physical Chemistry;* **91**: No. 11, 2701-2704(21 May 1987).

Microcrystalline cadmium, indium, copper, and zinc sulfides were generated in situ on the surface of bilayer lipid membranes (BLMs) prepared from bovine-brain phosphatidylserine (PS), glyceryl monooleate (GMO), and a synthetic, polymerizable surfactant $[n\text{-}C_{15}H_{31}CO_2(CH_2)_2]_2N^+(CH_3)CH_2C_6H_4CH$ double bond CH_2, Cl^- (STYRS). Semiconductor-containing BLMs remained stable for days. Semiconductor formation on the BLM surface was monitored by optical microscopy, voltage-dependent capacitance measurements, and absorption and intracavity-laser-absorption spectroscopy. Band gap excitation of GMO- BLM-incorporated CdS resulted in the development of photovoltage. Irradiation of CdS incorporated into BLMs formed from STYRS (using a 350-nm cutoff filter) led to absorption losses due to the styrene moiety in the surfactant. Apparently, CdS sensitized the photopolymerization of STRYS BLMs.

35351 **Preparation of cationic intermediates by dissociative photoionization of van der Waals complexes. $C_6H_6Cl^+$ from a C_6H_6 + HCl mixture.** Walters, E.A.; Grover, J.R.; White, M.G.; Hui, E.T. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **91**: No. 11, 2758-2762(21 May 1987). Contract AC02-76CH00016.

The ion $[C_6H_6Cl]^+$ (1) has been observed as a product of dissociative photoionization of a C_6H_6 + HCl van der Walls complex. It was shown that 1 does not come from the dimer C_6H_6 x HCl but from trimers or larger clusters, most likely $(C_6H_6)_2HCl$. Experiments with C_6D^6 + HCl mixtures demonstrate that the departing hydrogen initially belonged to the HCl partner of the complex. The energetics and isotope studies are consistent with an ipso structure for $C^6H^6Cl^+$, i.e., a Wheland σ-complex. The overall process of dissociative photoionization does not have an accessible reaction channel leading to $C_6H_6Cl\mu$ unless at least one solvent molecule is present. Mechanisms by which the transformation may occur are discussed.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 35321, 35816, 35823

35352 **Isotopic exchange in gamma-irradiated mixtures of $C_{24}H_{50}$ and $C_{24}D_{50}$: Evidence of free radical migration in the solid state.** Clough, R.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Chemical Physics;* **87**: No. 3, 1588-1595(1 Aug 1987).

Irradiation of a 1:1 co-melted mixture of tetracosane-h_{50} and tetracosane-d_{50} in the solid state resulted in isotopic exchange in very high yield [G(H—D) = 25]. Exchange was not observed for a similar isotopic mixture irradiated in the liquid phase. A mathematical model, which operates by iterative computer calculations, has been constructed to simulate the complex changes in isotopic peak patterns which arise in the irradiated solid mixture. The simulations show that the observed isotopic exchange is not random, but rather that an individual molecule which has once undergone an isotopic exchange has an enhanced probability of undergoing additional exchanges. The results are very consistent with the occurrence of a localized chain-reaction process specific to the solid phase, and they provide evidence supporting the hypothesis that free radical transport in solid organics occurs extensively by a repetitive "hydrogen-hopping" mechanism involving successive hydrogen abstractions. It can be estimated that the average number of H—D exchanges occurring per radical pair, from formation to termination, is 14.3.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 34603

35353 **(AD-A—178304/2/XAB) Preliminary design of a landfill and revetment on Bikini Island, Republic of the Marshall Islands. Final report.** Smith, O.P.; Chu, Y.H. (Coastal Engineering Research Center, Vicksburg, MS (USA)). Feb 1987. 59p. (CERC—87-5). NTIS, PC A04/MF A01.

Topsoil on Bikini Island, located 2,500 miles southwest of Hawaii at 113 deg 35 min N, 165 deg 25 min E, was contaminated by radioactive fallout from nuclear weapons tests in the late 1940's and early 1950's. The uptake of this radioactive fallout, primarily cesium-137 in plants, has prevented resettlement of the island by the native population. One alternative solution proposed by the congressionally appointed Bikini Atoll Rehabilitation Committee involves removal of the contaminated topsoil and placement of the excavated material as a landfill on the 2,500-ft-wide reef flat adjacent to the eastern (windward) shore of the island. This paper explores that alternative by first developing an extremal wave climatology offshore of Bikini Island from 21 years (1959-1979) of typhoon data published by the Joint Typhoon Warning Center on Guam. Deepwater wave conditions just offshore of the reef are estimated and transformed to the point of breaking at the edge of the reef. Storm surge is estimated based on these same parameters. Wave setup on the reef flat is estimated based on the simulated breaking conditions. Given an estimate of the elevated water level across the reef caused by storm surge and wave setup, depth limitations and fractional decay are estimated to define wave conditions at the toe of the proposed revetment. A rubble-mound revetment design stable in these conditions, armored by coral limestone quarried from the reef flat, is then formulated and corresponding material quantities estimated.

35354 **(BNL—39712) Hot oxygen atoms: Their generation and chemistry.** Ferrieri, R.A.; Chu, Yung Y.; Wolf, A.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 11p. (CONF-870507—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010057.

From 13. international hot atom chemistry symposium; Mount Fuji, Japan (24 May 1987).

Oxygen atoms with energies between 1 and 10 eV have been produced through ion beam sputtering from metal oxide targets. Argon ion beams were used on Ta_2O_5 and V_2O_5. Results show that some control may be exerted over the atom's kinetic energy by changing the target. Reactions of the hot $O(^3P)$ with cis- and trans-butenes were investigated. (DLC)

35355 **(IS-T—1253) Synthesis and characterization of several cesium zirconates and a study of their relevance to fission product chemistry.** Chen, Teng-Ming. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010936.

Investigations of the reaction of CsI with excess ZrO_2 in various containers at 400 to 850°C have successfully demonstrated the formation of ZrI_4 and Cs_2ZrO_3 in low yields (<35%). Macroscopic amounts of the cesium zirconates have been synthesized from reactions of Cs-Zr-O_2 in silver crucibles or of Cs-CsO_2-ZrO_2 and CsO_2-Zr in welded silver tubing at 600 to 750°C for one to two weeks. These reactions have produced four new compounds: Cs_2ZrO_3 and Cs_4ZrO_4 each in 95 to 100% yield, and two ZrO_2-richer cesium zirconates in 40 to 50% yield. The crystal structures of the first two phases have been solved by single crystal methods. Cs_2ZrO_3 is structurally related to K_2ZrO_3 or Cs_2PrO_3 and crystallizes in the orthorhombic space group Cmcm with a = 11.256(6), b = 7.738(5) and c = 5.967(7) A, Z = 4 (R = 5.2%). Cs_4ZrO_4 crystallizes in the monoclinic space group $P2_1/c$ with a = 7.163(1), b = 19.919(2), c = 7.158(1) A and β = 103.05(8)°, Z = 4 (R = 3.2%). The third zirconate crystallizes in a triclinic cell with a = 10.254(1), b = 10.416(2), c = 10.104(1) A, α = 106.45(1)°, β = 98.51(1)°, and γ = 100.17(1)°. The fourth zirconate crystallizes with

a monoclinic cell, a = 9.926(5), b = 15.359(8), c = 20.642(8) A, and β = 103.28(3)°. Cs_2ZrO_3 and Cs_4ZrO_4 decompose into Cs_2O and ZrO_2 or Cs_2ZrO_3 at near 915°C and 260 to 280°C under high vacuum, whereas in sealed silver containers they are stable to above 900°C and to 730 +- 20°C, respectively. The relevance of the formation and properties of these zirconates to the distribution of fission products is also discussed.

35356 **(ISH—64) Investigations on the quality of eluates from seven fission Mo-99/Tc-99m generators.** Hammermaier, A.; Reich, E.; Endrulat, H.J.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Mar 1985. 84p. NTIS, PC E09; Available from NTIS as TIB/B86-10123.

Seven different Mo-99/Tc-99m generators, based on fission Mo-99, from seven different manufacturers were studied from September 1984 to January 1985 with regard to their performance and to the quality of the eluates. Results for elution efficiencies, radionuclidic purity, Mo-99 breakthrough, radiochemical purity, pH, and aluminium content of the eluates are presented.

35357 **(LBL—23366) Recoil spectrometer for the detection of single atoms.** Ghiorso, A. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 12p. (CONF-870430—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010095.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

A much improved version of our gas-filled spectrometer for heavy-ion-induced fusion reactions is described. This instrument (SASSY II) is of the type D-Q-D wherein the dipoles are made with strong vertically-focussing gradients. The problems associated with experiments with cross sections in the picobarn range are discussed. In such experiments, it is necessary to identify single atoms with a high degree of confidence.

35358 **(PNL/SRP—6215) Salt Repository Project: Data report on solubility of $Pu(OH)_3$(s).** Rai, D.; Schramke, J.A.; Ryan, J.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010616.

Plutonium (III) hydroxide is expected to be one of the important solid phases of Pu (III), which is the dominant oxidation state under reducing environments such as those produced by the presence of steel in the waste package. Because the accurate solubility product of $Pu(OH)_3$ and the solubility of $Pu(OH)_3$ in high-ionic-strength solutions, such as brines, are not available, experiments were conducted to determine the solubility of $Pu(OH)_3$ in brines and in dilute solutions. This data report details the experiments conducted and the results obtained for $Pu(OH)_3$ solubility in different solutions. The results presented here are preliminary and have not yet been thoroughly analyzed and evaluated. This report will be followed at a later date by a summary or topical report that will include the interpretation of these results. 1 ref., 7 tabs.

35359 **Method for the simultaneous preparation of radon-211, xenon-125, xenon-123, astatine-211, iodine-125 and iodine-123.** Mirzadeh, S.; Lambrecht, R.M. (to Dept. of Energy, Washington, DC). US Patent 4,664,869. 12 May 1987. Filed date 1 Jul 1985. vp.

A method is described for simultaneously preparing a mixture of about equal amounts of /sup 211/Rn and /sup 125/Xe, and a second mixture of about equal amounts of /sup 211/At and /sup 123/I with a proton-irradiation procedure followed by a one-step chemical procedure. The method comprises: irradiating a body of material selected from the group consisting of /sup 232/Th and /sup 238/U for about 15 hours with protons that have been accelerated to at least 2 GeV; promptly dissolving the irradiated body of material in a vessel containing a mixture of hydrochloric acid, nitric acid and hydrofluoric acid; and forcing a stream of helium (He) carrier gas into the vessel at a predetermined flow rate to entrain radionuclides of gaseous /sup 210/Rn, /sup 211/Rn, /sup 123/Xe and /sup 125/Xe and trace amounts of radiohalogens and remove them from the vessel.

35360 **Biomedical silver-109m isotope generator.** Wanek, P.M.; Steinkruger, F.J.; Moody, D.C. (to Dept. of Energy, Washington, DC). US Patent 4,664,892. 12 May 1987. Filed date 5 Mar 1985. vp.

A method is described of producing substantially pure silver-109m for use in biomedical techniques. The method comprises: loading an aqueous solution of cadmium-109 onto an ion exchange substrate consisting essentially of tin phosphate; allowing secular equilibrium to be attained; and selectively eluting silver-109m from the column with an eluent solution to produce an eluate solution which contains the silver-109m and which is sufficiently free of cadmium to permit administration to a human patient.

35361 **Isotopic generator for bismuth-212 and lead-212 from radium.** Atcher, R.W.; Friedman, A.M.; Hines, J. (to Dept. of Energy, Washington, DC). US Patent 4,663,129. 5 May 1987. Filed date 30 Jan 1985. vp.

In an isotopic generator system, a method of using thorium-228 supply material disposed in a radiologically controlled portion of the system for producing radionuclides of bismuth-212 and lead-212 in a cation exchange resin bed, comprising the steps of: (a) separating radium-224 from a solution of thorium-228 supply material in an approximately 8 molar nitric acid in the radiologically contained portion by passing the solution through a strongly basic anion exchange resin; (b) transferring the radium-224 to the cation exchange resin bed from the radiologically contained portion; (c) producing the bismuth-212 and lead-212 radionuclides by decay of the Radium-224 in the cation-exchange resin bed; and (d) eluting the bismuth-212 and lead-212 from the cation exchange resin bed with th acid.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 34542, 34568, 35298

35362 **(AD-A—178001/4/XAB) Novel application of topological indices. 2. Prediction of the threshold soot index for hydrocarbon fuels. Technical report.** Hanson, M.P.; Rouvray, D.H. (Georgia Univ., Athens (USA). Dept. of Chemistry). 6 Mar 1987. 28p. (TR—40). NTIS, PC A03/MF A01.

See also report dated 16 Jul 86, AD—A170-127.

The propensity of hydrocarbons to form soot in a diffusion flame is correlated here for the first time against various topological indices. Two of the indices, the hydrogen deficiency index, and the Balaban distance-sum connectivity index were found to be especially valuable for correlational purposes. For a total of 98 hydrocarbon fuel moelcules, of differing types, regression analyses yielded good correlations between the threshold soot indices (TSIs) for diffusion flames and these two indices. An equation that can be used to estimate TSI values in fuel molecules is presented.

35363 **(AD-A—178792/8/XAB) Solid-fuel combustion - some mathematical problems.** Bebernes, J.W. (Colorado Univ., Boulder (USA)). 1986. 18p. NTIS, PC A02/MF A01.

Pub. in Rocky Mountain Jnl. of Mathematics, Vol. 16, No. 3, 417-433(Sum 1986).

The initiation of a combustion process involves a myriad of complex physical phenomena. In general one is concerned with the time-history of a spatially varying process occurring in a chemical heat release, diffusive effects associated with the transport properties, bulk-material motion as well as several types of propagating wave phenomena. Mathematical models capable of describing these combustion systems incorporate not only familiar reaction-diffusion effects associated with rigid materials, but those arising from material compressibility as well. For a combustible gas, the complete reactive Navier-Stokes equations are required to describe the phenomena involved. This paper focuses on the initiation and evolution of thermal-explosion processes in rigid materials. In this situation the physical processes are determined by a pointwise balance between chemical heat addition and heat loss by conduction. The mathematical system that describes a thermal-reaction event for a gaseous fuel in a bounded container is given. Also, it is shown how the complete system can be simplified for a rigid fuel to reactive

diffusive system, and to the ignition model by activation-energy asymptotics.

42 ENGINEERING

REFER ALSO TO CITATION(S) 36189

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 34564, 34819, 34844, 34859, 35402, 35506

35364 **(AD-A—177871/1/XAB) Chemical warfare protective clothing: identification of performance limitations and their possible solution.** Pandolf, K.B.; Allan, A.E.; Gozalez, R.R.; Sawka, M.N.; Stroschein, L.A. (Army Research Inst. of Environmental Medicine, Natick, MA (USA)). 27 Jan 1987. 8p. NTIS, PC A02/MF A01.

The major factors that contribute to the increased thermal burden imposed by chemical warfare (CW) protective clothing are the insulation characteristics (clo) and the evaporative impedance (im) of the material; and, increased levels of energy expenditure for performing physical exercise while wearing these clothing systems. An approach to alleviating heat stress is through the use of auxiliary cooling. A number of prototype microclimate cooling systems at employ either air-cooled or liquid-cooled vests were shown to be effective in reducing soldier heat strain during exercise while wearing CW protective clothing in hot environments. This Institute also developed the ability to predict the thermal strain, water requirements, tolerance time, and optimal work-rest ratios for soldiers exercising in CW protective clothing in a wide variety of environmental conditions.

35365 **(AD-A—178988/2/XAB) Chemical defense collective protecion technology. Volume 1. Effects of airlock dimension, clothing, and exposure concentration on vapor transport. Interim technical paper, 4-7 February 1985.** Conkle, J.P.; Miranda, R.E.; Fischer, J.R.; Page, R.W.; Bartlett, D.L. (School of Aerospace Medicine, Brooks AFB, TX (USA)). Dec 1986. 36p. (USAFSAM-TP—86-2-VOL-1). NTIS, PC A03/MF A01.

Procedures for processing personnel through chemical defense collective shelters were employed to examine the contamination of Toxic Safe Areas (TSAs), in shelters, as a result of transport of chemical agent vapor on clothing underlayers. The quantity of vapor thus transported into the TSAs was examined as a function of: airlock design; type of outer clothing worn during exposure; and vapor exposure concentration. A simulated Survivable Collective Protection Shelter Contamination Control Area facility, at the USAF School of Aerospace Medicine (Brooks Air Force Base, Texas), was employed. Personnel--addressed either in fatigues over T-shirt and jockey shorts, or in Flyer's charcoal undercoverall (United Kingdom) over aircrew undershirt and drawers--were first exposed to chemical warfare agent simulant (methyl salicylate) vapor, and were then processed through the Liquid Hazard Area and Vapor Hazard Area. Processing included passage through either the original design airlock or a modified design airlock before entry into the TSA. Inside the TSA, individual subjects were isolated within sealed-glass offgassing booths; and vapor offgassed from each subject over a 2-h period was measured. Data indicate that the charcoal undercoverall (UK) reduced the quantity of vapor transported into the TSA, and hence increased the protection of the individual more than did the fatigues. However, no statistical evidence of airlock differences was found.

35366 **(DP-MS—86-191) Autonomous vehicle development at the Savannah River Laboratory.** Fisher, J.J.; Byrd, J.S.; Martin, T.P. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 13p. (CONF-870474—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010189.

From Robotics II conference; Chicago, IL, USA (26 Apr 1987).

The Savannah River Laboratory (SRL) is developing intelligent mobile vehicles for deployment in nuclear applications at the Savannah River Plant (SRP). This paper reviews some process applications that have been performed in the nuclear industry with remote teleoperated vehicles and describes approaches of integrating intelligent mobile systems. A control hierarchy is being developed at SRL to allow vehicles to autonomously navigate and perform simple tasks in known environments. Knowledge-based expert systems are being evaluated to assist in navigation functions, to analyze sensory information, and to simplify operator control. Development work using two research vehicles is underway to demonstrate semiautonomous operations in process areas. A description of the mechanical equipment, control systems, and operating modes of these vehicles is presented.

35367 **(EPRI-EL—4152-Vol.2) Optimization of induction motor efficiency: Volume 2, Single-phase induction motors: Final report.** Fuchs, E.F.; Huang, H.; Vandenput, A.J.; Holl, J.; Appelbaum, J.; Zak, Z.; Erlicki, M.S. (Colorado Univ., Boulder (USA). Dept. of Electrical and Computer Engineering; Electric Power Research Inst., Palo Alto, CA (USA)). May 1987. 530p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920441.

The optimal design of the motor dimensions, the capacitance of the run capacitor, the winding distribution and the choice of the electrical steel are the most important sources for an improvement of the efficiency of modern single-phase induction motors for given performance and material cost constraints. The formulation of the techniques which realize this optimization is based on nonlinear programming approaches. The Method of Boundary Search Along Active Constraints is used for the optimal design of the motor dimensions of a commercially available 2 hp, 115 V single-phase induction motor. Based on the optimization results due to the above mentioned four optimization components, the relationships between efficiency, power factor, cost, active materials and the values of the capacitance of the run capacitor are studied and the limited validity of the model law is discussed. This report also explains why the Wanlass retrofit improves efficiency and details the advantages and disadvantages of such a retrofitting as compared with the operation in the standard configuration.

35368 **(EPRI-NP—5060) A compendium on mobile robots used in hazardous environments: Final report.** Meieran, H.B. (Meieran (H.B.) Associates, Pittsburgh, PA (USA)). May 1987. 227p. Research Reports Center, Box 50490, Palo Alto, CA 94303. File Number TI87920459.

This report presents a compendium of information regarding specific mobile robotic/teleoperated vehicles which are employed in a spectrum of hazardous environments, including the nuclear industry. These devices can be used to inspect, locate, identify, manipulate, and/or maintain components and items in the hazardous environment as well as act as mobile surveillance/sensing/reconnaissance platforms while monitoring the various constituents in the hazardous atmospheres. Furthermore, they can be used as transporters of tools, equipment, and material to and from the hazardous environment. This initial compendium is restricted to those devices which are able to maneuver on the surface of floors and other terrain features in both out-of-water and shallow water situations; subsequent compendiums will present information regarding underwater devices which can be used in the nuclear/fossil fueled/hydraulic based electric power generating and other utility industries and information updates for the initial volume. This compendium excludes those devices which are being considered for applications in outer space. 17 refs.

35369 **(NP—7770099) Stability and vibration of turborotors with gap excitation as a function of the bearing characteristics.** Ebner, F. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 4 Jul 1985. 136p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770099.

The author discusses the dynamic loads and instabilities occurring in turbomachine rotors with increasing power density and rotational speed. A description of the excitation mechanisms is followed by the development of mathematical models of the system and a discussion of the limit of stability and the bearing stability. The damping characteristics and the unbalance-type vibration

curves are investigated. The experimental facility is described, and the measured findings are discussed. (HAG).

35370 **(NP—7770101) Linear and nonlinear calculations of the loads and bearing capacity of thin-walled and thick-walled pipe bends with internal pressure and bending momentum.** Weber, E. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 23 Jul 1985. 146p. (In German). NTIS (US Sales Only), PC A07. File Number DE87770101.

The mechanical behaviour of pipe bands under internal pressure and bending momentum is investigated. A method of calculation is presented which covers the whole range of strain and deformation states, including nonlinear material behaviour, by means of the finite element method. The calculations are presented for elastic and plastic material behaviour. (HAG).

35371 **(PB—87-164356/XAB) Testing of a personal-filter cassette with a circumferential orifice.** McCawley, M.; Burkhart, J.; Baron, P.; Dollberg, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1983. 24p. NTIS, PC A02/MF A01.

A new personal filter cassette with circumferential orifices for personal inhalable-dust concentration measurements was tested using coal dust, and compared to standard closed face and open-face cassettes. The new cassette has four orifices separated by small posts with a slot-like geometry located circumferentially around the side of the cassette filter holder. The collection of coal dust was sampled in a laminar-flow chamber with the three types of cassettes at different orientations to the air flow. Uranine-tagged potassium biphthalate particles were used to test the uniformity of distribution on the filter surface. The test results indicated that the circumferential cassette appears to give a uniform distribution of dust across the filter surface. As this surface is protected like the surface in the closed-face cassette, this cassette may have some advantages over either of the other two.

35372 **(SAND—86-1690) Experimental analysis of Kevlar modification for TRUPACT-I puncture panels.** Longenbaugh, R.S.; Joseph, B.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010525.

The Kevlar Test Services was initiated to determine the maximum failure force and the energy-absorbing capability of puncture panels consisting of 16, 20, and 24 layers of 3000-denier 4 x 4 basket weave Kevlar-29, bonded to a 3.41 mm 304 annealed stainless steel puncture plate. Results of these tests were compared to the TRUPACT-1 Unit-0 drop test results to determine if the existing puncture panel configuration of TRUPACT-1 could be reduced. The data indicate for 24 layers of Kevlar, the panels failed at loads greater than those recorded in the TRUPACT-1, Unit 0 tests. Energy absorbed by the 24-layer Kevlar panels was 53% greater than that measured in the TRUPACT-1, Unit 0 test. Thermal performance of 20-layer Kevlar panels was measured in a conservative test environment and exceeded the design specifications.

35373 **(SAND—86-2275) Target effects on package response: An experimental and analytical evaluation.** Gonzales, A. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 190p. (TTC—0696). NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87010528.

Sandia National Laboratories has completed an experimental and analytical evaluation to compare the effects of a simple model transportation cask impacting on targets encompassing a range of stiffnesses. The cylindrical shaped unit was impacted into soil, concrete, and "unyielding" targets at velocities varying from 44 ft/s (30 mph) to 110 ft/s (75 mph). The 44 ft/s impact velocity correlates directly to a 30-ft drop height used in regulatory testing. 18 refs., 69 figs., 8 tabs.

35374 **(SAND—86-2762C) Evaluation and mapping of heatshield flight temperature and composition with laser Raman spectroscopic techniques.** Auerbach, I.; Tallant, D.R.; Higgins, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 27p. (CONF-870623—5). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010039.

From 22. AIAA thermophysics conference; Honolulu, HI, USA (8 Jun 1987).

A laser Raman spectroscopic technique has been developed which can measure the peak temperatures experienced by charring heatshield materials and determine their post test compositions (char, pyrolysis material and virgin resin). The technique has the capabilities of (1) analyzing areas less than 0.004 in. in diameter, or lines 0.004 in. in width and 0.075 in. in length, thereby providing fine detail for surface and internal mappings, and (2) performing the analyses rapidly and conveniently in the laboratory following testing or flight recovery. Representative plots of temperature and composition profiles are provided.

35375 **(SAND—87-1378C) Rebuilding/updating of Cincinnati Gilbert Milling Machine.** Shaw, D. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 4p. (CONF-8706108—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009842.

From Maintenance seminar; Oak Ridge, TN, USA (2 Jun 1987).

This report discusses the rebuilding and updating of a milling machine in USC at Sandia National Laboratories. After 15 years of use, it was found necessary to refurbish the machine. In order to make it more useful, modern controller, modern motors, and new measuring scales were added to the machine. The cost of the rebuild was $287,000, a price far less than the $800,000 price of a new unit. (JDH)

35376 **(UCID—21045) BOLT design of bolted connections.** Liniecki, A. (San Jose State Univ., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009247.

BOLTI is an interactive computer code used to select statically loaded bolts. The program selects an adequate size bolt in 3 different load cases: simple static tensile load applied on a compressed joint; simple static tensile load applied on two compressed members; simple static transverse shear load applied on a compressed joint. The user supplies Z4 input parameters and the program selects a bolt based on the data. The output includes bolt diameter, hole diameter, and necessary lightening torque. (JDH)

35377 **(UCRL—15815) Practical equipment seismic upgrade and strengthening guidelines.** Hom, S.; Kincaid, R.; Yanev, P.I. (EQE, Inc., San Francisco, CA (USA)). Sep 1986. Contract W-7405-ENG-48. 145p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010342.

The purpose of this document is to provide US Department of Energy (DOE) facility managers, safety personnel, and engineers with practical guidelines for implementing an equipment strengthening and upgrading program. The simple seismic upgrades presented in this manual are designed to be an extremely cost-effective method of enhancing the seismic safety of facilities and reducing the potential for major economic loss that can result from equipment damaged or destroyed by an earthquake.

35378 **(UCRL—92987) Development and research trends in ultraprecision machining.** McClure, E.R. (Lawrence Livermore National Lab., CA (USA)). 1985. Contract W-7405-ENG-48. 26p. (CONF-8508234—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008741.

From International machine tool research forum; Chicago, IL, USA (20 Aug 1985).

The increasing trend toward automatic manufacture and demands for improved quality are intensifying the old argument over whether precision is achieved by inspection or by process design. Other demands for ultraprecision are being created by the competiton in computers and frontier technologies such as high energy lasers. In response to these demands, advances are being made in

laboratory studies of material removal processes. Current advances in understanding the chip-forming process, fixed-abrasive and free-abrasive material removal processes show definite promise of resulting in improved engineering of commercial ultraprecision machining processes.

35379 **Light reflecting apparatus.** Sawicki, R.H.; Sweatt, W. (to Dept. of Energy, Washington, DC). US Patent 4,664,488. 12 May 1987. Filed date 21 Nov 1985. vp.

A light reflecting apparatus, comprising: first means including a generally flat light reflecting surface which is resiliently bendable, to a limited extent; and second means connected with the first means and adjustably movable in different ways for causing the light reflecting surface to bend into different predetermined quadratic and cubic curvatures, depending upon the way in which the second means is adjustably moved, where quadratic and cubic curvatures are curvatures defined by quadratic and cubic mathematical equations.

35380 **Belt conveyor apparatus.** Oakley, D.J.; Bogart, R.L. (to Dept. of Energy, Washington, DC). US Patent 4,662,510. 5 May 1987. Filed date 13 Oct 1983. vp.

A belt conveyor apparatus is described comprising: means defining a conveyance path including a first pulley and at least a second pulley, an endless belt member adapted for continuous travel about the pulleys defining thereby an upper and lower reach, the endless belt member having a lower portion which engages the pulleys and an integral upper portion adapted to receive objects at a first location on the conveyance path and transport the objects to and then discharge the objects at a second location on the conveyance path; and motive means in communication with the means defining a conveyance path, for effecting the travel of the endless belt member about the conveyance path.

35381 **Damage-plastic loading surface model for concrete.** Chern, J.C.; Marchertas, A.H.; Bazant, Z.P.; Lin, F.B. (Argonne National Lab., IL, USA; Northwestern Univ., Evanston, IL, USA. Dept. of Civil Engineering). *Nuclear Engineering and Design;* **101**: No. 2, 107-125(May 1987). Contract W-31-109-ENG-38.

The paper presents a plasticity-type model which is characterized by normality, continuity, convexity and associatedness. It utilizes two loading surfaces, of which one describes the behavior associated with damage due to inelastic volume change (expansion from micro-cracking, or contraction from pore collapse or closure) and the other plasticity at no inelastic volume change. Since only one of these two surfaces is active at the same time, the formulation is equivalent to a single loading surface. The deviatoric section of the damage loading surface is a rounded triangle, and the Rendulic section meridians have the shape of a slanted ellipse. The loading surfaces are smooth and have no corners. Although the model involves approximately the same number of material constants as the previous models of similar capability, identification of these constants from test data is much simpler. The properties of the model are also more advantageous for numerical finite element applications. The model is shown to be capable of describing the basic uniaxial and multiaxial test data for concrete except degradation of material stiffness.

35382 **Designing for specific diffraction criteria by accounting for non-ideal aspects in holographic recording materials.** Benton, S.A.; Thornton, D.K. (Spatial Imaging Group, the Media Lab., Massachusetts Institute of Technology, 20 Ames Street, Cambridge, MA 02139). pp 87-92 of Materials and optics for solar energy conversion and advanced lighting technology. Lampert, C.M.; Holly, S. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860880—).

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Changes in the configuration of an holographic grating have to be anticipated in the fabrication of practical Holographic Diffractive Structures (HDSs) for solar illumination engineering. Because photographic material used in HDSs changes characteristics during processing, there is a change of slant angle (due to shrinkage or swelling, i.e. actual dimensional change of the emulsion) and a change of average refractive index (due to bleaching and fixing). Computer aided analyses of test data have been performed in a way that predicts, under a wide range of conditions and for any given holographic recording material, the exposures required to attain specific intended optimum illumination results. This model has been verified in experiments and has been used to design illumination geometries for HDSs that meet the intended and often site specific target conditions very accurately.

35383 **Design, fabrication and testing of a beryllium cryostat for 10 - 30K.** Oonk, R.L.; Linenberger, D.D.; Loudon, J.D.; Bernat, T.P. New York, NY; American Institute of Chemical Engineers (1986). 22p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

A cryostat system was designed which consisted of three major elements: an experiment module, a helium supply system, and a precision temperature control system. The experiment module consisted of three independent, thin-walled beryllium chambers. Each chamber could be temperature controlled to within 0.2K over a range of 10 - 30K, and each chamber contained a beryllium vacuum seal which operated over this range. Three systems were built and tested. Results of performance testing of the systems are given.

35384 **Development of a GIGA-g magnetic microcentrifuge. Theoretical considerations.** Moroz, P.E.; Findley, G.L. (New York Univ., NY). *Analytical Instrumentation (New York);* **13**: No. 3-4, 217-229(1985).

An ultracentrifuge capable of sustaining centrifugal fields of the order of 10^9 g is considered theoretically. The rotor, levitated and rotated in a magnetic field, is a hollow metallic microsphere or glass microsphere containing Fe, with a diameter of less than 1 mm. The filling of the microsphere with a liquid sample can be performed through a laser-drilled hole. A stopped image of the rotor can be observed during centrifugation by employing a microscope equipped with a picosecond or nanosecond illuminator. Luminescence thermomicroscopy is discussed as a possible method for temperature measurement.

4203 Lasers

REFER ALSO TO CITATION(S) 35940, 36096

35385 **(AD-A—178106/1/XAB) Midwest free-electron laser program. Annual report, 1 March 1986-28 February 1987.** Cerullo, L.J.; Epstein, M.; Marhic, M.E.; Rymer, W.Z.; Spears, K.G. (Midwest Bio-Laser Inst., Chicago, IL (USA)). 1 Mar 1987. 12p. NTIS, PC A02/MF A01.

Developments in infrared waveguides for laser-beam delivery include liquid-core fibers, germanium coated brass guides, whispering gallery waveguides, Bragg fibers, and waveguides with periodic structures. Studies of interaction of laser radiation with tissue over a broad range of wavelengths include absorption of radiant energy by chromophores in a light-scattered matrix, effects of heating with pulsed Nd-YAG lasers, and the use of the diffusion model of radiative transfer to optical dosimetry in clinical phototherapy. The development of picosecond laser instrumentation for neuroscience research allows for the simulation of the FEL in pulse duration, energy, and wavelengths. Effects of laser-beam energy in neural tissue were investigated. These studies included the effects of carbon dioxide laser energy on the rat spinal cord as determined by the evoked potentials recorded from dorsal white matter in the mid-thoracic cord. The latter showed no discernible effects for levels below those causing visible damage to the dorsal-column white matter. These studies indicate minimal thermal effects at levels corresponding to the onset of breakdown.

35386 **(AD-A—178176/4/XAB) Laser materials for the 0.67- to 2.5-micrometers range. Contractor report.** Toda, M.; Zamerowski, T.J.; Ladany, I.; Martinelli, R.U. (RCA Labs., Princeton, NJ (USA)). Mar 1987. 54p. (RCA-PRRL—86-CR-4). NTIS, PC A04/MF A01.

Basic requirements for obtaining injection laser action in III-V semiconductors are discussed briefly. A detailed review is presented of materials suitable for lasers emitting at 0.67, 1.44, 1.93, and 2.5 micrometers. A general approach to the problem is presented, based on curves of materials properties published by Sasaki et al. It is also shown that these curves, although useful, may need correction in certain ranges. It is deduced that certain materials combinations, either proposed in the literature or actually tried, are not appropriate for double heterostructure lasers, because the refractive index of the cladding material is higher than the index of the active material, thus resulting in no waveguiding, and high threshold currents. Recommendations are made about the most promising approach to the achievement of laser action in the four wavelengths mentioned above.

35387 **(AD-A—178659/9/XAB) Conduction cooling of Nd:glass slab lasers.** Reed, M.K.; Yamada, T.; Byer, R.L. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). 1986. 5p. NTIS, PC A02/MF A01.

Pub. in High Power and Solid State Lasers, Vol. 622, 42-45(1986).

Isolation cooling of slab-geometry solid-state lasers potentially solves a number of problems with direct cooling. A static gas-cooled Nd:glass slab laser was tested to determine the advantages and limitations of this type of cooling system. This paper reports on these tests and discusses approaches to improve the average power of such a laser.

35388 **(AD-A—178760/5/XAB) Grazing-incidence ellipsoidal reflector for longitudinally pumping short-wavelength lasers.** Young, J.F.; Macklin, J.J.; Harris, S.E. (Stanford Univ., CA (USA). Edward L. Ginzton Lab.). Feb 1987. 4p. (MIPR-ARO—122-84). NTIS, PC A02/MF A01.

Pub. in Optics Letters, Vol. 12, No. 2, 90-92(Feb 1987).

The authors propose use of a prolate ellipsoid for collecting and focusing soft x-ray radiation from a laser-produced plasma to longitudinally pump short-wavelength lasers. Total collection efficiencies greater than 20% at 10 nm into gain regions with aspect ratios of 25 are possible. This geometry offers several advantages with respect to present transverse multiple spot geometries.

35389 **(AD-A—178810/8/XAB) Review of far infrared free-electron laser characteristics and experiments.** Walsh, J.E. (Dartmouth Coll., Hanover, NH (USA). Dept. of Physics and Astronomy). 1986. 10p. NTIS, PC A02/MF A01.

Pub. in SPIE, Far Infrared Science and Technology, Vol. 666, 22-30(1986).

A brief introduction to the theory of free-electron laser operation is presented. Emphasis is on summarizing the characteristics needed for operation in the 10 - 1000 micrometer region of the spectrum. A survey of current far-infrared free-electron laser experiments is also included.

35390 **(AD-A—178833/0/XAB) Investigation of the transverse-discharge copper-vapor laser. Final report, 1 February 1983-31 May 1986.** Kim, J.J. (New Mexico Univ., Albuquerque (USA). Center for High Technology Materials). 31 May 1986. 19p. NTIS, PC A02/MF A01.

A transverse-discharge copper-vapor laser was developed using a fast flat-plate Blumlein pulse-forming circuit. A specific laser energy density of 50 micor J/CC was achieved. This is an order of magnitude higher than that achieved by conventional copper-vapor lasers. The high electric field/number density ratio allows operation with high temperatures of up to 1800 C and high buffer-gas pressures above atmospheric pressure.

35391 **(AD-A—178972/6/XAB) GaAs/AlGaAs diode lasers on monolithic GaAs/Si substrates.** Windhorn, T.H.; Turner, G.W.; Metze, G.M. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1986. 9p. (MS—6935A). NTIS, PC A02/MF A01.

Pub. in Materials Research Society Symposium Proceedings, Vol. 67, 157-164(1986).

One approach to the development of optical interconnects between silicon systems utilizes diode lasers fabricated in III-V epitaxial layers grown on Si wafers. The authors fabricated double-heterostructure lasers in gallium arsenide/aluminum gallium arsenide layers grown on a germanium-coated Si substrate, and both asymmetric large-optical-cavity (LOC) lasers and graded-index, separate-confinement heterostructure (GRIN-SCH) lasers in such layers grown directly on a Si substrate. The GaAs/AlGaAs layers were grown by molecular beam epitaxy on (100) p-Si substrates. Si and beryllium were used as the n- and p-type dopants, respectively. Oxide-defined stripe-geometry devices, 300 micro long, were fabricated using standard Gold tin and chromium gold metallizations for the n- and p-type contacts, respectively. The laser facets were formed by ion-beam-assisted etching. The double-heterostructure devices (8 micro stripe width), in which the active region contained about 10 mole percent AlAs, were evaluated using pulsed bias at 77 K. They produced power outputs up to 3.3 mW per facet and exhibited thresholds as low as 170 mA. Keywords: Lasers, Optical Interconnects, Optoelectronic Device.

35392 **(AD-A—178981/7/XAB) Piezoelectric Q switching of a CO_2 laser.** Marcus, S.; Stein, D.T. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Jan 1987. 4p. (JA—5894). NTIS, PC A02/MF A01.

Pub. in Review of Scientific Instruments, Vol. 58, No. 1, 128-130(Jan 1987).

Reactive Q switching of a CO_2 laser by means of a piezoelectrically actuated end reflector is reported. The high-frequency response of the piezoelectric transducer was maintained by optically polishing the transducer's surface directly instead of employing a separate mirror. Submicrosecond pulses at rates in excess of 100 kHZ were obtained. This technique is especially appropriate for generating high pulse rates in low-power lasers, as no lossy intracavity elements are required. (Reprints)

35393 **(AD-A—179021/1/XAB) Multimode rate-equation analysis for semiconductor lasers applied to the direct intensity modulation of individual longitudinal modes.** Yee, T.K.; Welford, D. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). Nov 1986. 8p. (JA—5797). NTIS, PC A02/MF A01.

Pub. in IEEE Jnl. of Quantum Electronics, Vol. QE-22, No. 11, 2116-2122(Nov 1986).

A multimode rate-equation model, including the effects of carrier diffusion, gain saturation, and mode-coupling gain, was developed. This model was used to analyze the direct intensity modulation of individual longitudinal modes in a channeled-substrate-planar laser (Hitachi HLP 1400). The carrier diffusion is shown to reduce the intensity modulation of all longitudinal modes by the same fixed factor, while the gain saturation and mode coupling modify the intensity modulation by a factor that is spectrally dependent relative to the main-mode frequency. The gain saturation and mode coupling also modify the frequency dependence of the intensity modulation of each individual mode in relation to the mode power. These features were experimentally confirmed.

35394 **(LA-UR—87-1517) Superlattice geometry for gamma-ray lasers.** Baldwin, G.C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 21p. (CONF-870412—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010103.

From General meeting of the American Physical Society; Crystal City, VA, USA (20 Apr 1987).

The central problem to developing a graser - that pumping can inhibit or destroy the Moessbauer and Borrmann effects - can conceivably be mitigated by a superlattice geometry, into which collimated coherent transfer radiation is introduced to form a multiwave Borrmann (or antiBorrmann) mode. This could also overcome the limitations of cooperation length and Fresnel number that otherwise restrict the size and performance of a superradiant graser.

35395 **(PTB-Me—42) Investigations into the angular fluctuations of a dye laser beam and their control for optimizing the frequency stability of dye lasers.** Yen Bingue. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Mechanik; Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). Feb 1983. 80p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-10247.

In the present thesis the influence of mode fluctuations on the laser frequency caused by angular fluctuations of the laser beam are investigated both experimentally and theoretically. A method to suppress the frequency instability and drift produced in this way is developed.

35396 **(PTB-Me—56) Spectral investigations into commercially available GaAlAs-laser diodes.** Abou-Zeid, A. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.). Abt. Mechanik). Jan 1984. 37p. (In German). NTIS, PC E07; Available from NTIS as TIB/B86-10260.

In the present report spectral investigations into commercially available GaAlAs-laser diodes at room temperature are treated. Firstly, the basic physical principles of the laser diode are considered including design, emission spectra and mode structure. The temperature control and the current supply of the diode are described subsequently. Finally, the measurement of the spectral properties of various laser diodes are presented in detail and the results discussed. The characteristic data are listed in the appendix.

35397 **(UCRL—96551) Medium power Nd^{3+}: Glass fiber array laser.** Zapata, L.E. (Lawrence Livermore National Lab., CA (USA); Miami Univ., Oxford, OH (USA)). 22 Apr 1987. Contract W-7405-ENG-48. 9p. (CONF-870584—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009851.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

For the first time, with continuous, moderate power operation of Nd^{3+}:glass fiber bundle laser is reported. The disordered fiber bundle laser consisted of 1450 fibers, each 100 μm in diameter, with 75 μm core, phosphate laser glass doped at 8 wt % Nd_2O_3. The laser fiber bundle was energized by a xenon flashlamp or, a cw argon arc lamp. A maximum energy of 0.8 J at 4.9 kW peak power was obtained in the pulsed flashlamp experiments while the maximum cw power of 25 W was obtained with the arc lamp. The loss coefficient of 0.0266 cm^{-1} was inferred from the data. Neither the pulsed nor the cw systems were optimized. The beam profile was imaged with low spatial resolution and found to be lobed. Beam structure is indicative of coherence. Calculations for a would be ordered fiber array laser show that the beam far field approximates a Fraunhoffer diffraction pattern for the total aperture as the beamlets fill the aperture area.

35398 **Predicting threshold and location of laser damage on optical surfaces.** Siekhaus, W. (to Dept. of Energy, Washington, DC). US Patent 4,667,101. 19 May 1987. Filed date 4 Feb 1985. vp.

A method is described for examining an optical surface having a predetermined normal operating power level and frequency to identify discrete areas that are damage prone, due to impurity in the area, at the normal operating power level and frequency of the surface, and for removing the impurity from one or more of the damage prone areas. The method includes the steps of: directing a laser beam at the optical surface, the beam having a power level from 10/sup -2/ to 10/sup -1/ of the normal operating power level. The frequency of the beam is at or very near the frequency to be used at the normal operating power level; detecting the photoelectric emission from the damage prone areas of the optical surface to identify the damage prone areas.

35399 **Topical meeting on short wavelength radiation: Generation and applications: Summaries.** Washington, DC; Optical Society of America (1986). 138p. Optical Society of America, 1816 Jefferson Place NW, Washington, DC 20036. File Number TI87009183. Contract FG05-85ER13420.

From Topical meeting on short wave length coherent radiation; Monterey, CA, USA (24 Mar 1986).

Summaries are given of papers presented. Topics include: free-electron lasers, x-ray microscopy, x-ray lasers, photoionization pumped lasers, laser-produced plasmas, nonlinear generation, coherent imaging, multiphoton ionization, and spectroscopic applications. (WRF)

35400 **High power millimeter and submillimeter wave lasers and gyrotrons.** Temkin, R.J.; Cohn, D.R.; Danly, B.G.; Kreischer, K.E.; Woskoboinikow, P. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 10-15 of Millimeter wave technology III. Wiltse, J.C. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1985). (CONF-8504109—).

From SPIE technical symposium - East '85; Arlington, VA, USA (8 Apr 1985).

High power sources of coherent radiation in the millimeter and submillimeter wavelength range are useful in a number of applications, including plasma heating, plasma diagnostics, radar and communications. Two of the most important sources in this wavelength range are the optically pumped laser and the gyrotron. Major recent advances in both laser and gyrotron research are described. Possible techniques for improving the efficiency and operating characteristics of these devices are also reviewed.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 34544

35401 **(AD-A—177888/5/XAB) Numerical simulation of a randomly heated, thermally unstable fluid. Memorandum report.** Dahlburg, R.B.; Picone, J.M.; Mariska, J.T. (Naval Research Lab., Washington, DC (USA)). 31 Dec 1986. 27p. (NRL-MR—5911). NTIS, PC A03/MF A01.

Numerical simulations examine the response of a radiation driven thermally unstable fluid medium to randomization of the heating rate. Condensed structures develop more quickly as the heating becomes more spatially and temporally variable. Furthermore, the duration and intensity of the radiation events are altered. An analysis is presented which indicates that increasing the amplitude of temperature perturbations will lead to increases in radiated energy output.

35402 **(NP—7770097) Hydrodynamics of jet nozzle loop reactions.** Leber, L. (Paderborn Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 13 - Chemie und Chemietechnik). 21 Jun 1985. 197p. (In German). NTIS (US Sales Only), PC A09. File Number DE87770097.

The author is concerned with the mixing behaviour of single phase jet nozzle loop reactors, which are used as chemical reactors, bio-reactors, or as mixers. As an introduction, loop reactors are described and the literature survey is dealt with. In the context of theoretical considerations, apart from the fluid dynamics basis, transfer functions and physical parameters are examined. The experimental plant with the jet nozzle loop reactors, the dosing device and the device for determining the dwell time behaviour and the execution of the experiments are described. Finally, the results of the experiments are discussed, where particular attention is paid to the recirculation and mixing behaviour. Various computer programs are introduced in the appendix. (HAG).

35403 **(UCRL—95512) Pseudospectral computations illustrating shock wave turbulence amplification in viscous flow.** Buckingham, A.C. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 13p. (CONF-870712—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008493.

From Numerical methods in laminar and turbulent flow; Montreal, Quebec, Canada (6 Jul 1987).

Pre-existing turbulence may be significantly amplified by shock waves. Qualitative confirmation exists from shock tube and supersonic wind tunnel shock wave boundary layer interaction experiments. The former rarely provide accurate quantitative data, since probe survival and resolution sensitivity are jeopardized by shock pressure, temperature, and brevity of measurement duration. The latter, shock boundary layer interaction experiments, are ex-

tremely difficult to interpret since the process is obscured by the complex flow structure, the general turbulence questions, and the ill-defined interaction. Detailed numerical simulations are sought to provide verification and isolate dominant mechanisms. In the present work, pseudospectral Navier-Stokes simulations are developed which either capture the shock or track and fit it as a moving computational boundary.

35404 **Analysis of a Monte Carlo method for nonlinear radiative transfer.** Larsen, E.W.; Mercier, B. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Computational Physics;* 71: No. 1, 50-64(Jul 1987).

It has recently been proven that solutions of nonlinear radiative transfer problems satisfy a maximum principle (Andreev, Kozmanov, and Rachilov, U.S.S.R. Comput, Math. Math. Phys. 23, 104 (1983); Mercier, SIAM J. Math. Anal., in press). In this article it is shown that Monte Carlo solutions of such problems, obtained using the method of Fleck and Cummings (J. Comput. Phys. 8, 313 (1971)), must satisfy this maximum principle for sufficiently small time-steps, but can violate it for sufficiently large time-steps. Analyses of the frequency-dependent and grey cases ae given, and a numerical solution violating the maximum principle is discussed. copyright 1987 Academic Press, Inc.

35405 **Heat transfer from a heated tube in shallow vibrated beds.** Thomas, B.; Sprung, R.; Liu, Y.A.; Squires, A.M. New York, NY; American Institute of Chemical Engineers (1986). 52p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

The objective of this study was to develop the experimental systems and measurement methods to permit an accurate measurement of surface-to-bed heat transfer in vibrated beds (i.e., beds of solids that are levitated or "fluidized" by external vibrations alone) and to obtain a better understanding of the mechanisms of vibrated-bed heat transfer. Specifically, a fully-instrumented vibrated-bed system equipped with a computerized heat probe capable of maintaining an essentially constant surface temperature has been successfully designed, constructed and tested. The system was used to quantitatively investigate the effects of key operating variables, such as vibrational intensity and particle size, on the surface-to-bed heat transfer. In addition, through the use of video recording, strobe lighting, colored tracer particles, phase-shifted photography and instantaneous floor-pressure measurements, significant new insights were obtained on the bed structures, solid circulation patterns and air gap formations along with their effects on surface-to-bed heat transfer.

35406 **Analysis of gas flow through erupting bubbles in a gas fluidized bed.** Levy, E.K.; Chen, H.K.; Radcliff, R.; Caram, H.S. New York, NY; American Institute of Chemical Engineers (1986). 38p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

As bubbles erupt from the surface of a gas fluidized bed, particles are projected upwards into the freeboard. Some are subsequently carried from the bed by their initial momentum and by the gas motion and others fall back onto the bed surface. In order to relate the design and operating characteristics of the fluidized bed to elutriation rate, it is necessary to have information on quantities such as the rate of flow of gas across the free surface of the bed in the vicinity of the erupting bubble and the variation of gas velocities at the free surface during the course of the bubble eruption. As a bubble moves upward towards the free surface, it carries gas with it, but there can also be a net flow of gas through the bubble. During the period of the actual eruption, vertical gas velocities in excess of those in the surrounding emulsion phase occur, resulting in a brief transient vertical flow of gas through the site of the erupting bubble. Precisely when this burst of gas flow begins and how long it lasts during a typical bubble eruption are not known. Only very limited quantitative information is available on the nature of the gas flow patterns which issue from the top of an erupting bubble. Measurements previously made using hot film probes, a laser Doppler anemometer and with flow visualization techniques show that the burst of gas flowing through the site of the erupting bubble forms a vortex motion at the free surface. The vortex has also been linked to the turbulent fluctuation patterns occurring in the freeboard above the surface of the bed.

35407 **A study of fine particles residence time in a jetting fluidized bed.** Yang, W.C.; Keairns, D.L. New York, NY; American Institute of Chemical Engineers (1986). 44p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

Experiments were carried out to study the fine particles residence time in a 30-cm diameter laboratory fluidized bed. Fines, -170+230 mesh with an average size of 75 μm, were injected both radially and coaxially to simulate different fines recycle possibilities in an actual operating unit at two different bed heights and three different bed operating conditions. It was found that the transitory time of fines from the bed surface to the collecting cyclone dipleg and filter dominated the characteristic particle collection times. The experimental results were corrected for this transitory time by solving 25 simultaneous equations to arrive at the true fines residence time in the bed. The true fines residence time in the bed is in the order of 10 to 20 seconds, however, the experimental uncertainties in the current experiments do not allow exact determination of the residence time distribution.

4205 Materials Testing

REFER ALSO TO CITATION(S) 35138, 35189, 35374

35408 **(AD-A—178265/5/XAB) High-pressure studies using energy-dispersive diffraction of high-energy x rays. Final technical report.** Sherman, W.F.; Haeusermann, D. (King's Coll., London (UK). Wheatstone Physics Lab.). Feb 1987. 42p. NTIS, PC A03/MF A01.

The smooth continuum of white radiation produced by a 160-kV generator was combined with energy-dispersive x-ray diffraction (EDXRD) and a Drickamer-type cell for high-pressure studies. The theory of EDXRD is briefly reviewed and the advantages of the technique, high penetration and improved resolution, are discussed. The results of measurements of the compressibility of TiB up to 80 kbar are reported. The technique developed has also been used with the high energy radiation produced by the UK Synchrotron Radiation Source Wiggler. A simple diffractometer, designed and built for energy-dispersive diffraction of such radiation is described. Results of measurements of the compressibility of TiB_2 up to 130 kbar are presented.

35409 **(FhG-W—4/84) Experimental results on the stress behaviour of three point bending samples in inverted impact order. Interim report.** Boehme, W.; Kalthoff, J.F. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). 1984. 38p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-05364.

The first results showed that after the impact of the two counterbearing fins, the sample is not at first pressed against the actual measuring position. Rather there is a loss of contact between the sample and the measuring position. The stress at the crack tip rises, although the measuring position still shows zero load. Shortly afterwards there is another impact, this time between the sample and the measuring position. However, the relative speed occurring here is less than the original impact speed of the two fins. Because of this behaviour, as in the usual impact arrangement, there is no agreement between the course of the crack tip stress and the measured load on the resting fin. The inverted impact arrangement provides better agreement in the next time period. 29 references, 16 figures, 1 table.

35410 **(LA-UR—87-255) Diffusion in shock activated Be-Al interfaces.** Elliott, N.E.; Staudhammer, K.P.; Johnson, K.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-870725—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005096.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

The objective of this study was to obtain initial information on the diffusion of solid aluminum clad beryllium subjected to an explosive shock loading environment. The post shock elemental concentration profiles were evaluated as a function of time and temperature. An experimental approach allows the routine and convenient observation of effects of shock pressures from roughly 1GPa to 170GPa in a single sample. The exact pressures achieved are dependent on the material being shocked.

35411 **(UCRL—93487) Lamb wave diagnostics with the acoustic microscope.** Weglein, R.D.; Benson, S.E.; Vasudevan, N. (Lawrence Livermore National Lab., CA (USA); California Inst. of Tech., Pasadena (USA)). 9 Oct 1985. Contract W-7405-ENG-48. 8p. (CONF-8510219—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008739.

From IEEE ultrasonics symposium; San Francisco, CA, USA (16 Oct 1985).

The excitation of Lamb Waves is easily and simply accomplished in the acoustic microscope. Velocity measurements of Lamb waves in a variety of thin plates will be described and compared with the computed dispersion in an isotropic plate. Velocity measurement is obtained through the Acoustic Material Signature technique (AMS). Symmetric Lamb wave velocities in a Cu sheet and of the antisymmetric Lamb wave in a thin Si membrane are reported. A particular use of nondestructive diagnostics with Lamb Waves is in materials elastic property investigation. The excitation of Lamb waves of both symmetry groups in sheets of metallic glass has been achieved. From the measurement of velocity dispersion in both modes, the sheet thickness and computed dispersion curves, it is shown how elastic material properties may be obtained.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 34816, 35230, 35284, 35400, 35530, 35939, 36091

35412 **(CONF-870723—3) Electron transport studies of gaseous media for diffuse discharge closing switches.** Hunter, S.R.; Carter, J.G.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02. File Number DE87005327.

From 18. international conference on phenomena in ionized gases; Swansea, UK (13 Jul 1987).

High current, self-sustained diffuse discharges may be used as alternatives to spark gaps in fast closing, high repetition rate switching applications. The primary motivation for using diffuse discharges in comparison with arc discharges is that a diffuse discharge has a much faster recovery time ($<10^{-4}$ s) in comparison with an arc discharge ($>10^{-3}$ s). The major disadvantages with self-sustained diffuse discharges are the high impedance (i.e., low switch efficiency; presently 50 to 80% at bet) and the inherent instability of the discharge. This paper describes measurements of the electron drift velocity, w, electron attachment coefficient, eta/N/sub T/, and ionization coefficient, α/N/sub T/, in a new type of gas mixture which can be used in these switches to considerably lower the operating voltage of the diffuse discharge (i.e., increase the switch efficiency), while at the same time improving the discharge stability.

35413 **(GEPP-TIS—1015) Moisture analysis of small hermetically sealed devices.** Mauldin, C.B. (General Electric Co., Largo, FL (USA). Neutron Devices Dept.). 8 Jun 1987. Contract AC04-76DP00656. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010693.

Moisture, even in small quantities, can have serious detrimental effects on small electronic devices. Therefore, there is a growing interest in developing methods to analyze moisture in package ambients of hermetically sealed devices. The General Electric Neutron Devices Department (GEND) has developed methods to measure moisture and other ambient gases in small hermetically sealed devices. Volumes as small as 0.01 cm^3 at atmospheric pressure have been analyzed down to a level of 300 parts per million. Results of this analysis are given in this report. Samples as large as 10 cm^3 at atmospheric pressure have also been successfully analyzed.

35414 **(SAND—87-0205C) A model describing hot-carrier and radiation effects in MOS transistors.** McBrayer, J.D.; Pastorek, R.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—10). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006121.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

In this paper the relative types and magnitudes of damage produced by ionizing radiation and hot carriers for a current CMOS technology and how these effects are related are discussed. A model that qualitatively describes these effects is presented.

35415 **(SAND—87-0272C) Sandia/NRL [Navel Research Laboratory] interlaboratory comparison of low-energy x-ray and cobalt-60 irradiations of MOS transistors.** Dozier, C.M.; Brown, D.B.; Fleetwood, D.M.; Winokur, P.S. (Sandia National Labs., Albuquerque, NM (USA); Naval Research Lab., Washington, DC (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—8). NTIS, PC A02. File Number DE87005883.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

An interlaboratory comparison of low-energy x-ray and Co-60 irradiations of MOS transistors has been performed. These results bring previous differences in comparison factors into much closer agreement, and provide insight into the processes of electron-hole recombination and interface dose enhancement.

35416 **(SAND—87-0285C) Mechanisms for interface-trap generation in polysilicon gate devices.** Schwank, J.R.; Winokur, P.S.; Dressendorfer, P.V.; Turpin, D.C.; Sanders, D.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005842.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Interface-traps have been measured on transistors immediately after a pulse of ionizing radiation using a fast subthreshold I-V technique. Results are presented for interface-trap generation as a function of temperature and for different process conditions. These studies more clearly identify the physical mechanisms of interface-trap generation for polysilicon gate CMOS devices.

35417 **(SAND—87-0286C) Failure mechanisms of integrated circuits in space.** Winokur, P.S.; Sexton, F.W.; Hash, G.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-870724—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005848.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Failure mechanisms in low-dose-rate space environments are identified for ICs from hardened and commercial CMOS technologies and from advanced bipolar technologies. These failure mechanisms are often quite different than those observed at higher dose rates specified in total-dose test guidelines.

35418 **(SAND—87-0300C) Effects of process and geometry scaling on SEU hardness.** Fu, J.S.; Lee, K.H.; Weaver, H.T.; Browning, J.S. (Sandia National Labs., Albuquerque, NM (USA); Bell Telephone Labs., Inc., Allentown, PA (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-870724—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005845.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

The dependence of SEU hardness on the scale of circuit integration in memories has been investigated experimentally and

theoretically. Numerical simulations are used to separate effects of doping levels and vertical dimensions, which generally harden the cell with increasing integration, from effects of lateral dimension shrinkage, that have the opposite effect. These calculations are compared to SEU data from memories that were either (1) fabricated at Sandia using the CMOS-III 2μ process or (2) fabricated at AT & T using identical lateral dimensions, but with processes characteristic of the AT & T 1μ technology, i.e., different vertical dimensions and doping levels.

35419 **(SAND—87-0337C) An SEU tolerant memory cell derived from fundamental studies of SEU mechanisms in SRAM.** Axness, C.L.; McBrayer, J.D.; Weaver, H.T.; Browning, J.S.; Fu, J.S.; Ochoa, A. (Sandia National Labs., Albuquerque, NM (USA); Hughes Research, Carlsbad, CA (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005858.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Novel SEU experiments and advanced simulations are used to prove the feasibility of a new memory hardening scheme. Resistors are configured within the memory cell (1) to voltage divide the longer SEU induced transients at the information nodes, as well as, (2) to delay these transients by the conventional resistive decoupling technique.

35420 **(SAND—87-0408C) Hard error generation by thermal neutrons.** Browning, J.S.; Gover, J.E.; Wrobel, T.F.; Hass, K.J.; Nasby, R.D.; Simpson, R.L.; Posey, L.D.; Block, R.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—11). NTIS, PC A02/MF A01; GPO Dep. File Number DE87006128.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

The generation of hard errors in MNOS dielectric structures has been observed at thermal neutron fluence levels of 3.6×10^{13} n/cm^2. Fission fragments from neutron induced fission of ^{235}U contamination in ceramic lids have been shown to be responsible.

35421 **(SAND—87-1004C) Hardened technologies for hazardous environments.** Dawes, W.R. Jr. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 63p. (CONF-870724—15). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87008655.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

The complete radiation environment of neutrons, total dose, transient ionizing radiation, and energetic cosmic rays (SEU) can have various deleterious effects upon semiconductor electronic components. However, hardening techniques for these radiation effects have been developed for the various semiconduct technologies that will permit their use even in severe radiation environments. The process techniques are occasionally line dependent and may require modification to achieve the desired hardness goal. Similarly, hardening semiconductor components for elevated thermal operation can be achieved with process techniques which, unlike the radiation case, are readily transferable between process lines. Radiation effects and hardening technologies are discussed for Metal Oxide Semiconductor (MOS), Bipolar, Junction Field Effect Transistors (JFET), Metal Semiconductor Field Effect Transistor (MESFET), Diode, Electro-optic, and crystal technologies. 44 refs., 44 figs.

35422 **(SAND—87-7030C) Photocurrent modeling.** Enlow, E.W.; Stuetzer, O.; Alexander, D.R.; Barnum, J.R. (Sandia National Labs., Albuquerque, NM (USA); Mission Research Corp., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-870724—2). NTIS, PC A02/MF A01; GPO Dep. File Number DE87005065.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

Mathematical models are described for time dependent photocurrent in a PN junction. The models incorporate high injection effects on lifetime, electric fields in the bulk quasi-neutral region, and diode length effects. A subroutine suitable for use in SPICE 2 implements the models.

35423 **(SAND—87-7097C) A programmable test system for transient annealing characterization of irradiated MOSFETS.** Tausch, H.J.; Wemhoner, R.; Pease, R.L.; Schwank, J.R.; Maier, R.J. (Design Engineering, Inc., Albuquerque, NM (USA); Mission Research Corp., Albuquerque, NM (USA); Sandia National Labs., Albuquerque, NM (USA); Air Force Weapons Lab., Kirtland AFB, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—14). NTIS, PC A02. File Number DE87006894.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

A current programmable, computer controlled Transient Annealing Test System (TATS) for making post-irradiation subthreshold MOSFET I-V measurements is described. The system is capable of measuring transient log I/sub S/ versus V/sub G/ characteristics starting 100 μs after an ionizing radiation pulse and at source currents as low as 100 pA.

35424 **Subnanosecond high-voltage pulse generator.** Brown, D.; Martin, D. (Los Alamos National Laboratory, MS J957, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **58**: No. 8, 1523-1529(Aug 1987). Contract W-7405-ENG-36.

We developed a pulse generator that uses high-voltage step recovery diodes to produce 400- to 500-V pulses with rise and fall times of 0.8 ns. The output pulse width is continuously adjustable. For a pulse width of 0.8-ns FWHM, the amplitude into 50 Ω is 400 V. With the pulse-width control set at maximum, the output pulse amplitude is about 500 V and the width is 3.5-ns FWHM. The delay of the output pulse with respect to the input trigger is 38 ns with a jitter of about +- 30 ps. An unusual feature of the pulse generator is that the 38-ns delay time to the centroid of the output pulse is approximately constant and independent of the pulse width.

35425 **Effects of interface reactions on electrical characteristics of metal-GaAs contacts.** Yu, K.M.; Walukiewicz, W.; Jaklevic, J.M.; Haller, E.E.; Sands, T. (Center for Advanced Materials and Department of Instrument Science, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Applied Physics Letters;* **51**: No. 3, 189-191(20 Jul 1987). Contract AC03-76SF00098.

Solid-state interface reactions between metal thin films and (100) GaAs substrates at elevated temperatures are studied by conventional and heavy-ion Rutherford backscattering spectrometry, x-ray diffraction, and transmission electron microscopy. Metals investigated in this study include Pt, Pd, Ni, Co, Rh, and W. Electrical properties of the metal/n-GaAs diodes undergoing annealing treatments at various temperatures were also measured with the current-voltage dependence. Optimum diodes with maximum barrier heights as well as minimum leakage currents are obtained for diodes annealed at temperatures at which a uniform thin layer of reacted phase is observable at the interface. The barrier heights of the optimum diodes show a linear dependence on the work functions of the various metals. The range of these barrier heights is limited by nonstoichiometry related defects as suggested by a recently proposed amphoteric native defect model.

35426 **Impedance effects on anode formation of microparticles in an electron-beam diode.** Gray, E.W.; Rinehart, L.F. (Power Flow Research Div., Pulsed Power Components Div., Sandia National Labs., Albuquerque, NM 87185). pp 122-125 of Digest of technical papers of the 5th IEEE pulsed power conference. Turchi, P.J.; Rose, M.F. Piscataway, NJ; IEEE Service Center (1985). (CONF-850616—).

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Anode interactions in electron-beam diode cannot be ignored. A second impedance level in a microsecond-pulse, electron-beam diode with a carbon cathode has been identified. Production of spherical microparticles was also observed. These particles range in size from 0.2 to 60 μm diameter and their dimensions obey the

Rossin-Rammler (logarithmic extreme probability) distribution. These particles do not appear to be able to penetrate far enough into the vacuum space to participate in the bipolar flow on a μs time scale. However, they can damage the electrode support structures and cause spurious discharges on subsequent operation. Possible formation mechanisms of the spherical particles are presented.

35427 **XUV preionization effects in high power magnetically insulated diodes.** Maenchen, J.; Woodworth, J.R.; Foltz, B.W.; Burns, E.J.T.; Seidel, D.B.; Dorrell, L.R.; Johnson, P.R.; Reyes, P.; Torres, G.; Williams, G. (Sandia National Labs., Albuquerque, NM 87185). pp 102-105 of Digest of technical papers of the 5th IEEE pulsed power conference. Turchi, P.J.; Rose, M.F. Piscataway, NJ; IEEE Service Center (1985). (CONF-850616—). Contract AC04-76DP00789.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

Electrode surface desorption and photoionization by an intense XUV pulse has been shown to dramatically improve a vacuum diode impedance history. The 6-Terawatt Applied-B ion diode experiment on PBFA I is limited by a delay in both diode and ion current initiation. The insulation magnetic field impedes electron crossings which are believed to aid the ion source initiation. The diode is therefore initially a severe overmatch to the accelerator 40-nsec, 2.2-MV, 0.5-ohm pulse. The diode current increases during the pulse, leading to a rapidly falling impedance history. The application of an intense (30 to 50-kW/cm/sup 2/) XUV flux from an array of sixteen 60-kA spark sources is found to cause immediate diode current flow, resulting in both a greatly improved impedance history and the prompt initiation of an intense higher power ion beam.

35428 **Decomposition of CF/sub 4//Ar mixtures in corona discharges.** Sauers, I.; Evans, W.D.; Adcock, J.L.; Christophorou, L.G. (Atomic, Molecular and High Voltage Physics Group, Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 44-46 of Digest of technical papers of the 5th IEEE pulsed power conference. Turchi, P.J.; Rose, M.F. Piscataway, NJ; IEEE Service Center (1985). (CONF-850616—). Contract AC05-84OR21400.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

A number of gas mixtures have recently been proposed for use in diffuse discharge switch applications. Among these, the most promising are mixtures of perfluoroalkanes in rare gases (e.g., C/sub 2/F/sub 6/ in Ar). For practical systems in which repetitive operation is necessary, a switching gas must, in addition to satisfying the requirements of a fast opening switch such as high breakdown strength, an attachment rate constant that increases with increasing E/N (density normalized electric field), and high electron drift velocity at low E/N (typically —3 x 10/sup -17/ V cm/sup 2/), be reasonably stable to decomposition due to electron impact and/or thermal degradation. Even in cases where the decomposition rate of the original gas is small, the formation of by-products, having properties undesirable to the performance of the switch, may occur. In this paper data are reported on decomposition products and processes occurring in CF/sub 4//Ar mixtures as a result of electron initiated corona discharges.

35429 **Penning ionization ternary gas mixtures for diffuse discharge switching applications.** Nakanishi, K.; Christophorou, L.G.; Carter, J.G.; Hunter, S.R. (Atomic, Molecular and High Voltage Physics Group, Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 40-44 of Digest of technical papers of the 5th IEEE pulsed power conference. Turchi, P.J.; Rose, M.F. Piscataway, NJ; IEEE Service Center (1985). (CONF-850616—). Contract AC05-84OR21400.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

The increase in the total ionization produced by high energy α particles in Ar/C/sub 2/F/sub 6/ mixtures (which have conduction and insulation properties appropriate for use in diffuse discharge switching applications) by addition of low ionization energy additives has been quantitatively studied. The energy to produce an electron-ion pair (ip), W, in C/sub 2/F/sub 6/ was found to be 34.7 eV/ip; this rather high value is attributed to the large cross section for electron impact-induced dissociation of C/sub 2/F/sub 6/. The W values of Ar/C/sub 2/F/sub 6/ mixtures have also been measured and are reported; they increase with increasing C/sub 2/F/sub 6/ content. The W values of Ar/C/sub 2/F/sub 6/ binary gas mixtures have been found to decrease-higher total ionization-by addition of C/sub 2/H/sub 2/ or 2-C/sub 4/H/sub 8/. Quantitative measurements of the W values of the ternary gas mixtures are reported. The amounts of C/sub 2/H/sub 2/ or 2-C/sub 4/H/sub 8/ in Ar/C/sub 2/F/sub 6/ which maximize the increase in total ionization have been estimated; some of these ternary gas mixtures may be useful in e-beam sustained diffuse discharge switches.

4209 Waste Processing Plants And Equipment

35430 **(PB—87-167946/XAB) Doncaster waste-sorting plant - development leading to commissioning.** Douglas, E. (Warren Spring Lab., Stevenage (UK)). 1985. 53p. (LR—513(MR)-M). NTIS, PC PC E06/MF E06.

The report describes the involvement of the Department of the Environment, the South Yorkshire County Council, the Warren Spring Laboratory, and Motherwell Bridge Tacol Ltd in the development, up to commissioning, of a domestic refuse-sorting plant installed at Doncaster. All of the technical developments, from bench to continuous pilot scale followed by the initial full-scale operations, are described and accounts of the preparation and commercial testing of products are given. The main core of the plant operated effectively, but mechanical problems which still exist, mainly in the ancillaries and particularly in the glass and fiber recovery circuits, are noted. References are made to attempts at economic projects and some of the results, which are summarized, indicate limited financial incentives. Methods of technical and administrative control and practices are indicated and discussed in relation to associated problems and to decisions which influenced the project.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 34727, 35019, 35079

35431 **(DOE/MC/21391—2333) Alternative gas turbine injection techniques: Final report.** Dodge, L.G. (Southwest Research Inst., San Antonio, TX (USA). Fuels and Lubricants Research Div.; USDOE Morgantown Energy Technology Center, WV). Apr 1987. Contract AC21-84MC21391. 95p. (SWRI—8356). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001098.

Two topics are covered in this report: an examination of micronized coal-water slurry atomization using rotating cups and nozzles, and the injection and combustion of micronized powdered coal in gas turbine combustion systems. An important aspect of this work was the preparation and characterization of the coal powder and coal slurries.

35432 **(PB—87-168670/XAB) Evaluation of sulfur-capture capability of a prototype-scale controlled-flow/split-flame burner. Final report, September 1982-February 1984.** Vatsky, J.; Schindler, E.S. (Foster Wheeler Energy Corp., Livingston, NJ (USA)). Jan 1987. 190p. (REPT—5-E-3). NTIS, PC A09/MF A01.

The report describes the sulfur-capture potential during combustion of limestone copulverized with a high-sulfur eastern bituminous coal, using Foster Wheeler's commercial Controlled-Flow/Split-Flame (CF/SF) low NOx, internally staged burner. Sulfur capture was optimized by using overfire air and two proprietary flame-temperature-control methods. Additionally, the effects of excess air changes, load changes, and different calcium/sulfur mole ratios (Ca/S) were evaluated. Two flame-temperature-reduction methods were used to reduce the flame temperature to minimize dead burning of limestone and thus enhance SO_2 capture. Although the use of flame-temperature reduction and overfire air improved the SO_2 capture, the optimum SO_2 capture of 29% at a Ca/S of 2.15 was low. Operation under optimum SO_2 capture mode resulted

in measured NOx emissions of 0.19 lb/million Btu; CO was less than 25 ppm at an excess oxygen level of 3.0%.

35433 **(PB—87-179073/XAB) Ignition and combustion of liquid-fuel droplets. Part 1: impact on pollutant formation.** Rah, S.C.; Sarofim, A.F.; Beer, J.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering). 1986. 14p. NTIS, PC A02/MF A01.

Pub. in Combustion Science and Technology, Vol. 48, 273-284(May 1986).

The paper gives results of a study of the ignition process of liquid-fuel droplets and its impact on the formation of soot and nitrogen oxides (NOx). The system studied consists of a laboratory flame maintained by a vertical, monosized liquid-fuel droplet array surrounded by a laminar flow of a mixture of helium and oxygen. It was found that the formation of soot and NOx closely correlated with the ignition of liquid fuel droplets. It was shown that the soot formation can be suppressed by delaying ignition, and thus vaporizing as much fuel as possible prior to the ignition. But delaying ignition favors the conversion of fuel-bound nitrogen to nitric oxide (NO). The control of the emission of both soot and NOx can be achieved by use of low oxygen concentrations in the oxidation gas to delay ignition and suppress soot formation by using a high fuel/air ratio to reduce NOx.

4220 Underground Engineering

REFER ALSO TO CITATION(S) 34560

35434 **(PB—87-168662/XAB) Leak prevention in underground-storage tanks: a state-of-the-art survey.** Gangadharan, A.C.; Narayanan, T.V.; Raghavan, R.; Amoruso, G. (Enviresponse, Inc., Livingston, NJ (USA)). Mar 1987. 104p. NTIS, PC A06/MF A01.

The overall objectives of this study were to examine the structural design and operational practices associated with underground storage tank (UST) systems in the context of preventing leaks from such systems and identify areas for further research and development to advance the technology. Recommendations derived from this study include: establishing a national data base to provide information on failure rates and mechanisms and their correlation to design, engineering, installation, and operation practices and corrective actions; assessing the effectiveness of cathodic-protection methods, their interaction with the environment, and the performance of retrofitting existing USTs; developing compatibility protocols for the selection of appropriate materials of construction and long-term protection; and developing methods to assess the life expectancy of both new and existing systems and to extend their useful life.

4240 Pollution Control Equipment

35435 **(DOE/MC/21092—2331) Performance of an electrostatic precipitator on a bench-scale gasifier: Final report.** Rinard, G.A.; Rugg, D.E.; Durham, M.D.; Armstrong, J.A. (Denver Univ., CO (USA). Dept. of Engineering). Jan 1987. Contract AC21-84MC21092. 85p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87001096.

The objective was to evaluate the technical and economical feasibility of electrostatic precipitators (ESPs) as hot gas cleanup devices on combined cycle gasifier power plants. The program consisted of three tasks. The first was the bench-scale testing of an ESP on an actual gasifier at the Morgantown Energy Technology Center. The second was to investigate, in the laboratory, design principles related directly to the use of ESPs on gasifiers. The design principle tests were primarily to investigate clean electrode voltage-current characteristics and rapping efficiencies at high-temperature and high-pressure. The third task was to conceptualize a full-scale design and conduct an economic study of the use of ESPs for this application. The purpose of the bench scale tests was to obtain technical information on the operation of a high-temperature high-pressure electrostatic precipitator for application as a final particulate cleanup device on a coal gasification combined cycle power generating system. The specific objectives of the bench scale tests were to successfully operate the test module under actual gasifier conditions, to determine the level of particulate collection obtainable for these operating conditions, and to evaluate the technical feasibility of using electrostatic precipitators for this application. The bench scale tests were performed at the gasifier facility at the Morgantown Energy Technology Center. The purpose of the design principles tests was to obtain additional information on the operation of a precipitator at conditions typical of a coal gasifier that could be used in the conceptual design of a commercial scale precipitator. The design principles tests are distinguished from the bench scale tests in that they consisted of a series of experiments run under simulated gasifier conditions, whereas the bench scale tests were run on an actual gasifier fuel gas stream. 12 refs., 27 figs., 12 tabs.

35436 **(HEDL-SA—3610-VT) Aerosol scrubbers.** Sheely, W.F. (Hanford Engineering Development Lab., Richland, WA (USA)). 9 Sep 1986. Contract AC06-76FF02170. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010216.

The Submerged Gravel Scrubber is an air cleaning system developed by the Department of Energy's Liquid Metal Reactor Program. The Scrubber System has been patented by the Department of Energy. This technology is being transferred to industry by the DOE. Its basic principles can be adapted for individual applications and the commercialized version can be used to perform a variety of tasks. The gas to be cleaned is percolated through a continuously washed gravel bed. The passage of the gas through the gravel breaks the stream into many small bubbles rising in a turbulent body of water. These conditions allow very highly efficient removal of aerosols from the gas.

4250 Power Cycles

REFER ALSO TO CITATION(S) 34804

43 PARTICLE ACCELERATORS

35437 **(SLAC—311) Annual environmental monitoring report, January-December 1986.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009074.

Environmental monitoring and remedial actions at the Stanford Linear Accelerator Center are reported. The local climate, site geology, site water usage, land use, and demography are briefly reviewed. Among the activities reported are waste solvent tank remedial action and testing of underground storage tanks. The SLAC Linear Collider Project is discussed insofar as it impacts the environment. Neutron radiation dose to the surrounding environment and radioactive effluents are reported. (LEW)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 35820

35438 **(CONF-870498—6) The Holifield Heavy Ion Research Facility.** Jones, C.M.; Alton, G.D.; Ball, J.B.; Bigger-staff, J.A.; Dowling, D.T.; Erb, K.A.; Haynes, D.L.; Hoglund, D.E.; Hudson, E.D.; Juras, R.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009671.

From 7. tandem conference; Berlin, F.R. Germany (6 Apr 1987).

Development of the Holifield facility has continued with resulting improvements in the number of ion species provided, ion energy for tandem-only operations, and utilization efficiency. The Holifield Heavy Ion Research Facility (HHIRF) is located at the Oak Ridge National Laboratory and operated as a national user facility for research in heavy ion science. The facility operates two accelerators: an NEC pelletron tandem accelerator designed to operate at terminal potentials up to 25 MV and the Oak Ridge Isochronous Cyclotron (ORIC) which has been modified to serve as an energy booster for beams from the tandem accelerator. The princi-

pal experimental devices of the facility include a broad range spectrograph ($ME/q^2 = 225$) equipped with a vertical drift chamber detector system, a 4π spin spectrometer equipped with 72 NaI detectors (Ge detectors and BGO compton-suppression units can be used in place of the NaI detectors), a time-of-flight spectrometer, a 1.6-m scattering chamber, a heavy-ion/light-ion detector (HILI) which will be used for studying inverse reactions, a split-pole spectrograph, and a velocity filter. In this report, we will discuss our recent development activities, operational experience, and future development plans.

35439 **(DOE/ER/60439—2) The radiological research accelerator facility: Progress report for the period December 1, 1986-November 30, 1987.** (Columbia Univ., New York (USA). Nevis Labs.). Apr 1987. Contract FG02-86ER60439. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009702.

Experiments performed at the Radiological Research Accelerator Facility (RARAF) during the period of July 1986 through April 1987 are listed, as well as experiments run prior to that period and expected to eventually resume. The experiments run since July 1, 1986 or expected to run before November 30, 1987 are briefly described. Accelerator use and operation is summarized, as well as facilities development and activities of the Scientific Advisory Committee. (LEW)

35440 **(DOE/SF/00515—T75) Stanford Linear Accelerator Center monthly report for March 1987.** (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1987. Contract AC03-76SF00515. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008761.

Operational activities for the month of March 1987 are reported in the areas of accelerator and research operations, research area and experiment status, accelerator improvements, research division developments, and publications issued during the month. (LEW)

35441 **(FNAL-TM—1449) Initial operation of the Tevatron collider.** Johnson, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 6p. (CONF-870302—145). NTIS, PC A02. File Number DE87009036.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Tevatron is now the highest energy proton synchrotron and the only accelerator made with superconducting magnets. Operating since 1983 as a fixed-target machine at energies up to 800 GeV, it has now been modified to operate as a 900 GeV antiproton-proton collider. This paper describes the initial operation of the machine in this mode. The new features of the Fermilab complex, including the antiproton source and the Main Ring injector with its two overpasses and new rf requirements, are discussed. Beam characteristics in the Tevatron (including lifetimes, emittances, luminosity, beam-beam tune shifts, backgrounds, and low beta complications), the coordination of the steps in the accelerator chain, and the commissioning history are also discussed. Finally, some plans for the improvement of the collider are presented.

35442 **(LA-UR—86-2775) GTA [ground test accelerator] Phase 1: Baseline design report.** (Los Alamos National Lab., NM (USA)). Aug 1986. Contract W-7405-ENG-36. 436p. NTIS, PC A19/MF A01; 1; GPO Dep. File Number DE87007838.

The national Neutral Particle Beam (NPB) program has two objectives: to provide the necessary basis for a discriminator/weapon decision by 1992, and to develop the technology in stages that lead ultimately to a neutral particle beam weapon. The ground test accelerator (GTA) is the test bed that permits the advancement of the state-of-the-art under experimental conditions in an integrated automated system mode. An intermediate goal of the GTA program is to support the Integrated Space Experiments, while the ultimate goal is to support the 1992 decision. The GTA system and each of its major subsystems are described, and project schedules and resource requirements are provided. (LEW)

35443 **(LBL—22166) Mixing and matching Bevalac programs: Rapid-switching of ions and other operations highlights: Progress report.** Lothrop, F.; Alonso, J.; Krebs, G.; Miller, R.; Stevenson, R. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 5p. (CONF-870302—139). NTIS, PC A02. File Number DE87009157.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Rapid switching of ion, energy, and beam line has been accomplished on a routine basis; typical transfer time is 1 to 2 minutes in worst case situations. Operational efficiency has been improved by substantial reduction of inter-experiment tune time and improved optics in the external beam area installed in 1985. A comparison of current research efficiency and previous year efficiency is given. It is shown that compatibility and productivity for two simultaneous, independent research programs are not mutually exclusive.

35444 **(LBL—22168) The Bevalac Upgrade Project.** Alonso, J.R.; Dwinell, R.D.; Feinberg, B.; Frias, R.; Gough, R.A.; Howard, D.R.; Hunt, D.B.; Krebs, G.F.; Krupnick, J.T.; Lewis, S.A. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-870302—163). NTIS, PC A02. File Number DE87009330.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes a proposed upgrade of the Bevalac accelerator complex in which the present Bevatron is replaced with a modern, strong-focusing 17 T-m synchrotron. This new ring is designed to accelerate all ions throughout the periodic table with intensities 100 to 1000 times higher than the present Bevatron. It will also provide a substantially improved beam spill structure and will reduce operating costs. A fast extraction capability can be used to inject a future heavy ion storage ring. Pulse-to-pulse switching of energy and ion species is an important goal. The existing injectors, shielding, experimental facilities and utilities of the present Bevalac will remain substantially intact.

35445 **(LBL—22715) The LBL [Lawrence Berkeley Laboratory] 88-inch cyclotron operating with an ECR source.** Clark, D.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 26p. (CONF-8610271—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009174.

From 10. national conference on particle accelerators; Dubna, USSR (21 Oct 1986).

The features and operation of the LBL 88-inch Cyclotron are described, including its ECR source, injection system, and the cyclotron center region. The beams that have been accelerated at the cyclotron are discussed. (LEW)

35446 **(SLAC-PUB—4206) Some experiences from the commissioning program of the SLC arcs.** Fischer, G.E.; Brown, K.L.; Bulos, F.; Fieguth, T.; Hutton, A.; Murray, J.J.; Toge, N.; Weng, W.T.; Wiedemann, H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—179). NTIS, PC A02. File Number DE87009456.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The SLC Arc System is designed to transport beams of electrons and positrons from the end of the SLAC Linac to the beginning of the Final Focus System where they are made to collide head on. To minimize phase space dilution caused by quantum processes in the synchrotron radiation energy loss mechanism, the bending radii are large (279 m) and very high gradient ($n = 32824$) AG cells are arranged in trains of low dispersion, terrain following achromats. First experiences in operating a system of over 900 magnets, each with beam position monitors and corrector magnet movers, spanning 9000 feet, are described.

35447 (SLAC-PUB—4211) Construction and performance of a permanent earth anchor (tieback) system for the Stanford Linear Collider. Obergfell, M.N. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 8p. (CONF-870671—1). NTIS, PC A02/MF A01. File Number DE87006778.

From International symposium on prediction and performance in geotechnical engineering; Calgary, Alberta, Canada (17 Jun 1987).

The Stanford Linear Collider is the newest addition to the high-energy physics research complex at the Stanford Linear Accelerator Center. One of the many unique features of this project is the large, underground pit, where massive particle detectors will study the collision of subatomic particles. The large, open pit utilizes nearly 600 permanent earth anchors (tiebacks) for the support of the 56 ft (17 m) high walls, and is one of the largest applications of tiebacks for permanent support of a structure. This paper examines the use of tiebacks on this project with emphasis on their installation and performance.

35448 (SLAC-PUB—4263) The status of the Stanford Linear Collider. Stiening, R. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 8p. (CONF-870302—165). NTIS, PC A02. File Number DE87009450.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Stanford Linear Collider is described, and the status of commissioning of the major SLC systems is given, including the electron source and 1.2 GeV linac, storage rings, 50 GeV linac, and positron source. Beam transport between the linac and final focus, and the final focus optical system are described. (LEW)

35449 (TRI-PP—86-102) Recent developments at TRIUMF. Dohan, D.A. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1986. 10p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87900306.

After 12 years of successful operation as a meson factory, TRIUMF is entering a new era of machine development and production demands. Having met the original design specifications, TRIUMF now faces challenges beyond these expectations. A proposal has been submitted for the construction of a 30 GeV proton synchrotron, with the 500 MeV H^- cyclotron serving as the injector. Recent progress in a high intensity optically pumped polarized ion source promises to make available to experimenters tens of microamperes of polarized proton beams. Major improvements have been made in the mechanical and thermal stability of the resonator system to such a degree that flattopping with the third harmonic resonance can now be realistically planned. A high-brightness multicusp ion source has resulted in new records in peak extracted beam current. Significant extensions have been made to the central control system, allowing sophisticated high level techniques to be applied to tuning and reproducibility problems.

35450 (UCRL—96013) LLNL multi-user tandem laboratory. Proctor, I.D.; Davis, J.C.; Eaton, M.R.; Garibaldi, J.L.; Moore, T.L.; Schumacher, B.J.; Southon, J.R.; Zimmerman, T.A. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 14p. (CONF-870498—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008422.

From 7. tandem conference; Berlin, F.R. Germany (6 Apr 1987).

The Physics Department at Lawrence Livermore National Laboratory (LLNL) is building a new tandem Van de Graaff laboratory for nuclear physics and applied physics and technology programs. The laboratory has been funded by a coalition of users including several LLNL Divisions, Sandia National Laboratories Livermore, and the University of California. The tandem is the former University of Washington injector FN. The accelerator is upgraded with a Pelletron charging system, Dowlish spiral inclined field beam tubes and SF6 insulation. The laboratory incorporates several novel design concepts. Initial operation will be in June, 1987 with full operation in October, 1987. Design features, radiological controls, computer assisted operation, and experimental facilities of the laboratory are discussed.

35451 A status report on the PBFA II construction project. Barr, G.W.; Furaus, J.P.; Cook, D.L.; Shirley, C.G. (Sandia National Labs., Albuquerque, NM 87185). pp 162-167 of Digest of technical papers of the 5th IEEE pulsed power conference. Turchi, P.J.; Rose, M.F. Piscataway, NJ; IEEE Service Center (1985). (CONF-850616—). Contract AC04-76DP00789.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

The Particle Beam Fusion Accelerator II (PBFA II) is under construction at Sandia National Laboratories (SNL). PBFA II contains 36 individual power modules configured in a stacked radial geometry and synchronized to provide greater than 3.5 MJ of energy into the vacuum section in a single 55-ns-wide 90-TW peak power pulse. This R and D construction project is being implemented in a fast track schedule mode in which final design of the accelerator components occurs in parallel with the construction of the laboratory building and the accelerator tank. PBFA II is scheduled to become operational in January 1986 with its first multimodule shot into an applied-B ion diode that will generate and transport a beam of lithium ions. Plans are now being made for experimental work on PBFA II beyond the construction phase.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 35500

35452 (BNL—39595) An automatic beam steering system for the NSLS X-17T beam line using closed orbit feedback. Nawrocky, R.J.; Ma, Li; Rarback, H.M.; Singh, O.V.; Yu, L.H. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-870302—183). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010054.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Initial observations of motion of the undulator radiation in the NSLS X-17T beam line clearly indicated that the beam had to be stabilized in both directions to be usable for the planned soft x-ray imaging experiments. The low frequency spectra of beam motion contained peaks in the range from dc to 60 Hz and at higher frequencies. A beam steering system employing closed orbit feedback has been designed and installed to stabilize the beam in both planes. In each plane of motion, beam position is measured with a beam position detector and a correction signal is fed back to a local four magnet orbit bump to dynamically control the angle of the radiation at the source. This paper describes the design and performance of the beam steering system.

35453 (BNL—39607) Field measuring probe for SSC [Superconducting Super Collider] magnets. Ganetis, G.; Herrera, J.; Hogue, R.; Skaritka, J.; Wanderer, P.; Willen, E. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 4p. (CONF-870302—144). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008710.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The field probe developed for measuring the field in SSC dipole magnets is an adaptation of the rotating tangential coil system in use at Brookhaven for several years. Also known as the MOLE, it is a self-contained room-temperature mechanism that is pulled through the aperture of the magnet with regular stops to measure the local field. Several minutes are required to measure the field at each point. The probe measures the multipole components of the field as well as the field angle relative to gravity. The sensitivity of the coil and electronics is such that the field up to the full 6.6 T excitation of the magnet as well as the field when warm with only 0.01 T excitation can be measured. Tethers are attached to both ends of the probe to carry electrical connections and to supply dry nitrogen to the air motors that rotate the tangential windings as well as the gravity sensor. A small computer is attached to the probe for control and for data collection, analysis and storage. Digital voltmeters are used to digitize the voltages from the rotating coil and several custom circuits control motor speeds in the probe.

The overall diameter of the probe is approximately 2 cm and its length is 2.4 m; the field sensitive windings are 0.6 m in length.

35454 **(BNL—39608) A comparison of calculations and measurements of the magnetic characteristics of the SSC [Superconducting Super Collider] design D dipole.** Gupta, R.C.; Morgan, G.H.; Wanderer, P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-870302—141). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008711.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Measurements on two 4.5 m long design D dipoles are compared with computer calculations of their harmonics. These two magnets were tested at high fields, up to about 7.5 T, by subcooling.

35455 **(BNL—39609) Random errors in the magnetic field coefficients of superconducting quadrupole magnets.** Herrera, J.; Hogue, R.; Prodell, A.; Thompson, P.; Wanderer, P.; Willen, E. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 4p. (CONF-870302—142). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008712.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The random multipole errors of superconducting quadrupoles are studied. For analyzing the multipoles which arise due to random variations in the size and locations of the current blocks, a model is outlined which gives the fractional field coefficients from the current distributions. With this approach, based on the symmetries of the quadrupole magnet, estimates are obtained of the random multipole errors for the arc quadrupoles envisioned for the Relativistic Heavy Ion Collider and for a single-layer quadrupole proposed for the Superconducting Super Collider. (LEW)

35456 **(DESY-L-Trans—311) Beam loss distribution in IHEP proton accelerator at different stages of the accelerating cycle.** Akimtsev, A.I.; Aseev, A.A.; Zhuravlev, A.A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Sep 1986. 16p. NTIS, PC E07; Available from NTIS as TIB/B87-00250.

Translated from Russian. Published as preprint IFVE--83-20.

The results of beam losses measurement determined by beam dynamics in the accelerator during injection, acceleration and ejection and quantitative estimations of contribution to the accelerator equipment irradiation from particle losses during different stages of the cycle are presented. The coefficients obtained for beam loss monitors allow to make estimations (taking into account accelerator working modes) of the value for the dose absorbed by the equipment of any part of the accelerator circumference during the run. The results may be used to make a prognosis of equipment irradiation with rising accelerator intensity and new beam ejection modes.

35457 **(FNAL-TM—1441) Bunch coalescing in the Fermilab Main Ring.** Wildman, D.; Martin, P.; Meisner, K.; Miller, H.W. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 4p. (CONF-870302—134). NTIS, PC A02/MF A01. File Number DE87009034.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A new rf system has been installed in the Fermilab Main Ring to coalesce up to 13 individual bunches of protons or antiprotons into a single high-intensity bunch. The coalescing process consists of adiabatically reducing the h = 1113 Main Ring rf voltage from 1 MV to less than 1 kV, capturing the debunched beam in a linearized h = 53 and h = 106 bucket, rotating for a quarter of a synchrotron oscillation period, and then recapturing the beam in a single h = 1113 bucket. The new system will be described and the results of recent coalescing experiments will be compared with computer-generated particle tracking simulations.

35458 **(FNAL-TM—1445) Simulation of a programmed frequency shift near extraction from the Fermilab Booster.** Lucas, P.; Kerns, Q. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 4p. (CONF-870302—148). NTIS, PC A02. File Number DE87009029.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The longitudinal phase space program ESME has been used to simulate the effects of a linear shift in RF frequency away from that appropriate for the accelerator guide field. This shift takes place in the new Booster low level RF and is used to position the particle bunches in Main Ring buckets in a reproducible fashion. Shifts in frequency are found to generate synchrotron oscillations; however, the simulations show that these can be reduced to acceptable levels by introduction of jumps in RF phase preceding the programmed frequency changes. Lowering the RF voltage near extraction from the Booster, a desirable operational feature, has also been investigated.

35459 **(LA—10917-MS) Estimate of emittance growth due to sychrobetatron resonance driven by dispersion in rf cavities.** Suzuki, T. (Los Alamos National Lab., NM (USA)). May 1987. 14p. NTIS, PC A02/MF A01. File Number DE87009474.

Emittance growth by synchrobetatron resonance is estimated for the 6 GeV booster of the Advanced Hadron Facility. It is shown that the emittance growth is modest both for horizontal and vertical betatron motions if we avoid only the m = 1 resonance where the resonance condition is ν/sub x/ - mν/sub s/ = integer.

35460 **(LBL—22094) Monitoring relativistic heavy ion beams at the Bevalac.** Crebbin, K.C. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—161). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009329.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Beam fluence in high intensity proton and electron accelerators is usually measured with Secondary Emission Monitors (SEM) calibrated by an activation method. These were no such activation measurements available for relativistic heavy ion beams. Secondary electron production and energy loss of a charged particle in passing through material are a result of Coulomb interaction between the projectile field and electrons in the material. Therefore range measurements and secondary emission yield should follow the same functional relationship of velocity and charge as given by the Bethe-Bloch equation. A substantial amount of data on range in water for various ions has been collected at the Bevalac Biomedical facility. Using the same calculations that convert measured proton ranges to ion ranges and comparing the calculated values to measured values, provides an indirect way to verify the validity of the SEM calibration. The results of these measurements are discussed in this paper.

35461 **(LBL—22194) Single particle dynamics in the LBL 1-2 GeV synchrotron radiation source in the presence of magnetic imperfections, magnet displacement errors and insertion devices.** Jackson, A.; Nishimura, H. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—137). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009168.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The effects arising from sources of perturbing fields that can be predicted in advance of construction of the LBL 1 to 2 GeV Synchrotron Radiation Source are investigated. These include field errors (systematic and random) introduced through magnet design and finite construction tolerances; a random quadrupole component arising from a finite closed orbit distortion in the sextupoles; and the intrinsic focusing and nonlinear fields associated with the insertion devices (undulators and wigglers). (LEW)

35462 (LBL—22201) Operating results for the beam profile monitor system currently in use at Bevalac Facility. Stover, G.; Fowler, K. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—166). NTIS, PC A02. File Number DE87009624.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Three stations of a soon to be completed multi-station, multi-wire beam monitoring system have been installed in the Bevalac transfer line. The following article will provide a cursory analysis of the electronic circuitry, discuss new design additions and summarize the operating results obtained over the last year.

35463 (LBL—22212) Perturbation method for the measurement of longitudinal and transverse beam impedance. Barry, W.; Lambertson, G.R. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—155). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009162.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A perturbation method utilizing metallic and dielectric spheres to measure longitudinal and transverse beam and pickup impedances in accelerator components is described. The method was used to measure the longitudinal and transverse beam impedances of the 1 to 2 GeV light source beam pipe. In addition, the technique was used to measure the transverse pickup impedance of a 2 GHz cavity type Schottky signal monitor currently being installed in the FNAL Tevatron. Measurement results for both cases are presented.

35464 (LBL—22214) The effect of nonlinear forces on coherently oscillating space-charge-dominated beams. Celata, C.M. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 9p. (CONF-870302—174). NTIS, PC A02. File Number DE87009549.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A particle-in-cell computer simulation code has been used to study the transverse dynamics of nonrelativistic misaligned space-charge-dominated coasting beams in an alternating gradient focusing channel. In the presence of nonlinear forces due to dodecapole or octupole imperfections of the focusing fields or to image forces, the transverse rms emittance grows in a beat pattern. Analysis indicates that this emittance dilution is due to the driving of coherent modes of the beam near their resonant frequencies by the nonlinear force. The effects of the dodecapole and images forces can be made to effectively cancel for some boundary conditions, but the mechanism is not understood at this time.

35465 (LBL—22275) Experimental measurement of emittance growth in mismatched space-charge-dominated beams. Tiefenback, M.G. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-870302—180). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009446.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Using the Single Beam Transport Experiment (SBTE) at LBL, we have measured the emittance of a well-matched 4.6-mA beam of 122-keV Cs^+ to be conserved from injection into through exit from an 80-lens segment of the AG focussing channel. We then mismatched the beam into the same channel such that the maximum (minimum) radius of the beam at the midplane between lenses was about 1.5 (0.5) times the former value. We caused mismatches in the envelope of the beam in both transverse dimensions (labeled a and b) in modes both symmetric ($\delta a = \delta b$) and antisymmetric ($\delta a = -\delta b$). We found the mismatch amplitude to decay during the beam transit through the channel for both modes of mismatch, although more so for the antisymmetric mode. We also found the emittance of the symmetrically mismatched beam to be the same as for the matched beam, while the emittance of the antisymmetrically mismatched beam grew by as much as a factor of four over that for the matched beam.

35466 (SAND—87-0531) Recent Hermes III simulations. Poukey, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009534.

The 2-D electromagnetic PIC code MAGIC has been used to study the diode and MITL for Hermes III. Recent results are summarized, including H^- and H^+ orbits in typical diode configurations. Preliminary results on the effects of tapers and steps in the MITL are given.

35467 (SLAC-PUB—4087) Invariant surfaces and tracking by the Hamilton-Jacobi method. Warnock, R.L.; Ruth, R.D. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1986. Contract AC03-76SF00515. 3p. (CONF-870302—130). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008868.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The Hamilton-Jacobi method is described for a model of betatron motion in one degree of freedom, namely, a harmonic oscillator perturbed by a lattice of sextupoles. The Hamilton-Jacobi equation is given in terms of Fourier amplitudes. Invariant surfaces have been obtained in phase space, and finite time symplectic maps were obtained for tracking of single particles. (LEW)

35468 (SLAC-PUB—4088) Comparison of high group velocity accelerating structures. Farkas, Z.D.; Wilson, P.B. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—125). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008867.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

It is well known that waveguides with no perturbations have phase velocities greater than the velocity of light c. If the waveguide dimensions are chosen so that the phase velocity is only moderately greater than c, only small perturbations are required to reduce the phase velocity to be synchronous with a high energy particle bunch. Such a lightly loaded accelerator structure will have smaller longitudinal and transverse wake potentials and hence will lead to lower emittance growth in an accelerated beam. Since these structures are lightly loaded, their group velocities are only slightly less than c and not in the order of 0.01c, as is the case for the standard disk-loaded structures. To ascertain that the peak and average power requirements for these structures are not prohibitive, we examine the elastance and the Q for several traveling wave structures: phase slip structures, bellows-like structures, and lightly loaded disk-loaded structures.

35469 (SLAC-PUB—4096) Studies of anomalous dispersion in the SLC second order achromat. Fieguth, T.; Kheifets, S.; Murray, J.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 4p. (CONF-870302—122). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008871.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Certain causes of anomalous dispersion in the second order achromats of the SLC arcs are investigated. For matched dispersion, transverse displacements of combined function magnets do not introduce anomalous dispersion. This is shown by deriving a non-dispersive condition connecting the average of the matched dispersion function with the quadrupole and sextupole components of the field. In the SLC Arcs, however, the achromats are rolled producing a dispersion mismatch. In this case, the horizontal (vertical) dispersion is affected linearly by vertical (horizontal) displacement of magnets. The integral condition connecting the dipole and quadrupole fields and the matched dispersion is also derived. Combining this with the non-dispersive condition and the analytic expression of the matched dispersion gives two simple relationships for the fields of second order achromats constructed of combined function magnets. The effects of the dispersion mismatch in the SLC Arcs is investigated using computer simulations. The results show that this mismatch will increase the sensitivity to transverse errors. We report the effects of certain systematic errors.

35470 **(SLAC-PUB—4097) Transverse impedances of cavities and collimators.** Kheifets, S.A.; Bane, K.L.F.; Bizek, H. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 4p. (CONF-870302—177). NTIS, PC A02. File Number DE87009458.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Field matching has been used to compute the transverse impedance of simple, cylindrically symmetric, perfectly conducting structures, the subregions of which are separated by radial cuts. The method is briefly described, and some early results are presented. (LEW)

35471 **(SLAC-PUB—4184) Limitation of linear colliders from transverse rf deflections.** Seeman, J.T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1987. Contract AC03-76SF00515. 3p. (CONF-870302—129). NTIS, PC A02/MF A01; GPO Dep. File Number DE87008866.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Offaxis beam trajectories in a linear collider produce transverse wakefield and chromatic effects which cause emittance enlargement. One cause for non-centered trajectories in the accelerating structures is radial rf fields which produce transverse deflections. Static deflections can be compensated by static dipole magnetic fields. However, fluctuations of the rf fields cause variations in the deflections which must be managed or limited. Given the level of fluctuation of the phase and amplitude of an rf system, a limit on the allowable rf deflection can be calculated. Parameters, such as the beam emittance, lattice design, rf wavelength and the initial and final beam energies, influence the tolerances. Two tolerances are calculated: (1) one assumes that the wakefields are completely controlled, and that chromatic effects are the only enlarging mechanism (optimistic), and (2) the other assumes the limit is due to transverse wakefields without the aid of Landau damping (pessimistic).

35472 **(SLAC-PUB—4189) Analysis of orbit perturbations of the SLC arcs.** Weng, W.T.; Murray, J.; Chao, A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1987. Contract AC03-76SF00515. 3p. (CONF-870302—182). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009892.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The generation and correction of orbit errors are analyzed. A general stability criterion for the orbit correction is established and the rms orbit errors and corrector strengths are calculated. The formulation is then applied to the design of the Stanford Linear Collider to obtain estimates for residual orbit distortion after correction. (LEW)

35473 **(SLAC-PUB—4220) Phase detector and phase feedback for a single bunch in a two-bunch damping ring for the SLAC Linear Collider.** Schwarz, H.D.; Judkins, J.G. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 4p. (CONF-870302—126). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008875.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The synchronous phase of a bunch of positrons or electrons being damped in a SLAC Linear Collider (SLC) damping ring is dependent on beam intensity. Injection for alternate bunches into the SLC linac from the damping rings should occur at a constant phase. A phase detector was developed allowing the measurement of phase of a single-stored bunch in the presence of a second bunch in reference to the phase of the linac. The single-bunch phase is derived from beam position monitor signals using a switching scheme to separate the two bunches circulating in each damping ring. The hardware is described including feedback loops to stabilize the extraction phase.

35474 **(SLAC-PUB—4230) Betatron phase advance measurement at SPEAR.** Morton, P.L.; Pellegrin, J.L.; Raubenheimer, T.; Ross, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 2p. (CONF-870302—167). NTIS, PC A02. File Number DE87009451.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

There are many reasons to determine the betatron phase advance between two azimuthal positions in a circular accelerator or storage ring. We have measured the betatron phase advance between various pairs of azimuthal points in the SPEAR Storage Ring by two different methods. The first method is to excite a steady state coherent betatron oscillation with a network analyzer. The second method is to excite a free coherent betatron oscillation with an impulse kick, and to digitally sample the transverse position of the beam at the pickup stations. The results of these digital samples are Fourier analyzed with a computer to obtain the phase advance. The second method is discussed, and the experimental results compared to theory.

35475 **(UCRL—95366) Utilization of optical image data from the Advanced Test Accelerator (ATA).** Chambers, F.W.; Kallman, J.S.; Slominski, M.E.; Chong, Y.P.; Donnelly, D.; Cornish, J.P. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 9p. (CONF-870584—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009573.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

Extensive use is made of optical diagnostics to obtain information on the 50-MeV, 10-kA, 70-ns pulsed-electron beam produced by the Advanced Test Accelerator (ATA). Light is generated by the beam striking a foil inserted in the beamline or through excitation of the gas when the beamline is filled with air. The emitted light is collected and digitized. Two-dimensional images are recorded by either a gated framing camera or a streak camera. Extraction of relevant beam parameters, such as current density, current, and beam size, requires an understanding of the physics of the light-generation mechanism and an ability to handle and properly exploit a large digital database of image data. We will present a brief overview of the present understanding of the light-generation mechanisms in foil and gas, with emphasis on experimental observations and trends. We will review our data management and analysis techniques and indicate successful approaches for extracting beam parameters.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 35462

35476 **(ANL—87-14) Ring energy selection and extra long straight sections for the Advanced Photon Source.** (Argonne National Lab., IL (USA)). Apr 1987. Contract W-31109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009274.

Recommended criteria are given for the performance of Advanced Photon Source (APS), taking into consideration undulator tunability criteria and their relationship to the storage ring energy and undulator gap, length of straight sections.

35477 **(BNL—39477) Artificial intelligence and accelerator control.** Weygand, D.P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-870302—85). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007630.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

In this paper we review a knowledge-based, domain specific expert system which is under development at Brookhaven National Laboratory to aid in the control of the Heavy Ion Transfer Line (HITL). The expert system is being developed in order to minimize down time after a change of running conditions or at the start of a new run. While the control of HITL is relatively simple compared

to a synchrotron, conceptually, many of the problems that are encountered may be extrapolated to more complex machines.

35478 **(BNL—39550) Thermal management of magnetic focussing horns used in the narrow and broad band neutrino beams at the AGS.** Leonhardt, W.; Carroll, A.; Monaghan, R.; Pearson, C.; Pendzick, A.; Ryan, G.; Sandberg, J.; Sims, W.; Smith, G.; Stillman, P. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 13p. (CONF-870302—115). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008451.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Operation of the AGS Neutrino Horns and their internal and external targets takes place in an environment of high voltage, severe shock and vibration, and high radiation. To insure reliable operation, energy from Joulean heating and the proton beam interaction must be dissipated to keep component temperatures at the lowest levels practical. This has been accomplished by carefully choosing component materials and providing dedicated air and water cooling systems to transfer the 6 kW of heat efficiently and safely to the environment. This paper describes how the rigid horn and target thermal design constraints were satisfied, and provides some record of the current operating experience.

35479 **(BNL—39551) Ultraprecise magnet design and shimming.** Danby, G.T.; Jackson, J.W. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 13p. (CONF-870302—158). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009144.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Computer studies of pole design and magnet shimming techniques are discussed for a very precise 14.72 kG iron core storage ring magnet to be used for the proposed measurement of the muon anomalous magnetic moment. The experiment requires knowledge of the field in the 7m radius storage ring dipole to approximately 0.1 ppM (1×10^{-7}). The goal is to produce field uniformity of approximately 1 ppM. Practical and mathematical limitations prevent obtaining such accuracy directly with a computer code such as POISSON, which is used in this study. However, this precision can be obtained for perturbations of the magnetic field. Results are presented on the internal consistency of the computations and on the reliability of computing perturbations produced by Fe shims. Shimming techniques for very precise field modification and control are presented.

35480 **(BNL—39606) A single layer coil superconducting magnet for SSC [Superconducting Super Collider].** Gupta, R.C.; Morgan, G.H.; Thompson, P.A. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 3p. (CONF-870302—143). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008709.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The superconducting magnet under consideration for the proposed Superconducting Super Collider (SSC) uses a two layer coil geometry and is optimized for 6.6 T central field. In this paper we assess if it is possible to design a dipole having a realistic single layer coil configuration, using a cable having the same size as that used in the present SSC outer layer coil, can achieve a central field of about 6 T. The affirmative answer assumes a superconductor current density approaching the best achieved thus far in production, close-coupled cold iron with at most a very thin collar, a high but not unreasonable current density in copper at quench, and operation below 4.2 K. The performance under other operating conditions will also be discussed. We shall first describe the cable used in this design. We shall discuss the optimization procedure of the iron shape, particularly in the aperture region to minimize the effects of iron saturation. We shall outline the design of a realistic single layer coil geometry. Finally we shall discuss various operating parameters from the quench protection point of view.

35481 **(BNL—39636) Focussing horn upgrades.** Carroll, A.S. (Brookhaven National Lab., Upton, NY (USA)). Feb 1987. Contract AC02-76CH00016. 6p. (CONF-870283—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009143.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

A very brief overall description of the AGS neutrino area and the focussing horns is given. The short term status of the horns and possible upgrades are discussed. (LEW)

35482 **(BNL—39670) Status of the National Synchrotron Light Source.** Heese, R. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 7p. (CONF-870302—190). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010456.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

An overview of the present capabilities of the NSLS 750 MeV VUV ring and the 2.5 GeV x-ray ring is presented. Emphasis is placed on performance of the now operational facility, the efforts to improve this performance, a description of the "Phase II" upgrade, and outlook for the future.

35483 **(BNL—51988) Brookhaven Lecture Series: Using the light fantastic: Number 211.** Williams, G. (Brookhaven National Lab., Upton, NY (USA)). 16 Jan 1985. Contract AC02-76CH00016. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009459.

The National Synchrotron Light Source is described, along with the principles of its operation, the properties of its radiation, and some perspective on what research can be done with the radiation. (LEW)

35484 **(CONF-870498—2) Tests of compressed geometry acceleration tubes in the Oak Ridge 25URC tandem accelerator.** Jones, C.M.; Erb, K.A.; Haynes, D.L.; Mitchell, J.T.; Ziegler, N.F.; Raatz, J.E.; Rathmell, R.D. (Oak Ridge National Lab., TN (USA); National Electrostatics Corp., Middleton, WI (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008828.

From 7. tandem conference; Berlin, F.R. Germany (6 Apr 1987).

In an effort to further improve voltage performance of the Oak Ridge 25URC accelerator, the original acceleration tubes will be replaced with NEC compressed geometry acceleration tubes. In this paper, we report on tests in the 25URC accelerator of two prototype compressed geometry acceleration tube designs. One of the designs utilizes a novel aperture which provides enhanced electron and ion trapping.

35485 **(DOE/ER/40044—T1) Development of high field superconductors for high energy particle physics: Final report.** (Supercon, Inc., Shrewsbury, MA (USA)). 1 May 1987. Contract AC01-81ER40044. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87008722.

The purpose of this project was to develop a high current capacity superconductor for use in high energy accelerator magnets operating at fields above 10 tesla. The conductor was to be used in an experimental magnet designed by Brookhaven National Laboratory based on requirements for advanced accelerator applications. The wire specifications to be met were as follows: a Nb_3Sn conductor with a copper/non-copper ratio of 1:1; a wire diameter of 0.0268"; and a critical current density of 1000 A/mm^2 in a magnetic field of 10T. The scope of this work was to develop a process to manufacture such a conductor by testing a variety of fabrication techniques which examined variables such as: copper-to-filament area ratio; percentage of reacted Nb_3Sn per filament; the relative Nb-Sn interfacial area; and the behavior of the composite geometry during extrusion and drawing. Proper control of these variables could reduce filament bridging, coupling, and "sausaging," and thus improve the wire current density.

35486 (FNAL/C—87/76) The ACP [Advanced Computer Program] Branch bus and real-time applications of the ACP multiprocessor system. Hance, R.; Areti, H.; Atac, R.; Biel, J.; Cook, A.; Fischler, M.; Gaines, I.; Husby, D.; Nash, T.; Zmuda, T. (Fermi National Accelerator Lab., Batavia, IL (USA)). 08 May 1987. Contract AC02-76CH03000. 7p. (CONF-870552—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010567.

From 5. conference on real-time computer applications in nuclear particle and plasma physics; San Francisco, CA, USA (11 May 1987).

The ACP Branchbus, a high speed differential bus for data movement in multiprocessing and data acquisition environments, is described. This bus was designed as the central bus in the ACP multiprocessing system. In its full implementation with 16 branches and a bus switch, it will handle data rates of 160 MByte/sec and allow reliable data transmission over inter rack distances. We also summarize applications of the ACP system in experimental data acquisition, triggering and monitoring, with special attention paid to FASTBUS environments.

35487 (FNAL-TM—1443) The new FNAL Booster-to-Main Ring beam transport system. Syphers, M.J. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. 4p. (CONF-870302—146). NTIS, PC A02. File Number DE87009035.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

As part of the effort to improve the emittances of the FNAL accelerators, a new beam transport system has been installed between the 8 GeV Booster and the 150 GeV Main Ring synchrotrons. The new design generates vertical dispersion which matches that dispersion produced by the Main Ring DO vertical overpass. The biggest improvement may be the stronger focusing used throughout the new line, thus reducing the sensitivity of the transverse phase space matching of the two machines to small changes in quadrupole currents. Also included is a more passive injection system, a more flexible power supply configuration, plus improved diagnostics for measuring the Booster emittances and the phase space match to the Main Ring. The new beam transport system became operational in August of 1986. Results from the commissioning of the system are also described.

35488 (FNAL-TM—1447) New low-level rf system for the Fermilab Booster synchrotron. Kerns, C.; Crisp, J.; Kerns, Q.; Miller, H. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1987. Contract AC02-76CH03000. 4p. (CONF-870302—149). NTIS, PC A02. File Number DE87009030.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This paper describes the Booster low-level rf system that was constructed to meet these recently added requirements: (1) synthesizer controlled capture frequency at injection, (2) very low-phase noise over the machine cycle, (3) smooth phase-lock of beam to an external reference frequency and (4) ability to accelerate either a full turn or partial turn of beam.

35489 (GSI—86-2-Prepr.) Ion source with storage capability for bunched beam release and controlled chemical separation. Kirchner, R.; Klepper, O.; Marx, D.; Rathke, G.E.; Sherrill, B. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Jan 1986. 38p. NTIS, PC E07; Available from NTIS as TIB/B87-00440.

A discharge ion source of the FEBIAD-type is described which allows accumulation of various elements in a cooled trap and release of the stored atoms after a preselected time in a defined bunch. This bunching effect is systematically investigated for the elements Cu - Ge, Pd - Sb and Au - Bi as a function of temperature and of the trap materials graphite, zirconium, niobium, molybdenum and tantalum. The accumulation/release characteristics and the underlying adsorption/desorption mechanism are qualitatively explained in terms of the temperature and enthalpy of adsorption; the measured sequences of the elements may, with some reservation, be used to test theoretical predictions. Utilizing the differences in accumulation efficiency and release profile for neighbouring elements, a high degree of chemical selectivity may be achieved. This feature, important for mass-separation on-line, is illustrated by a test in which neutron-deficient Sn isotopes were investigated γ-spectroscopically with substantially reduced isobaric contamination of In, Cd and Ag. Additionally, the bunching itself strongly increases the peak-to-noise ratio in collinear laser spectroscopy, permitting the study of isotopes hitherto inaccessible due to low production rates. The extension of this new method to other elements and to higher release speed is outlined.

35490 (LA-UR—87-872) Experimental progress on virtual-cathode very high power microwave source development. Fazio, M.V.; Hoeberling, R.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-870302—135). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008985.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The evolution of rf accelerator technology toward high-power, high-current, low-emittance beams produces an ever-increasing demand for efficient, very high power microwave sources. The present klystron technology has performed very well but is not expected to produce reliable gigawatt peak-power units in the 1- to 10-GHz regime. Further major advancements must involve other types of sources. The reflexing electron sources can produce microwave powers at the gigawatt level and have demonstrated operation from 800 MHz to 40 GHz. Pulse length appears to be limited by electron-beam diode closure, and reflexing electron devices have been operated in a repetitively pulsed mode. An experiment is under way to investigate concepts to stabilize the frequency of the virtual cathode source. If one can successfully frequency and phase lock this source to an external signal, then this source can operate as a very high power microwave amplifier making it practical for accelerator applications. The progress on an experiment to test these concepts will be discussed.

35491 (LA-UR—87-1156) The LANSCE (Los Alamos Neutron Scattering Center) target system. Russell, G.J.; Robinson, H.; Legate, G.L.; Woods, R.; Whitaker, E.R.; Bridge, A.; Hughes, K.J. (Los Alamos National Lab., NM (USA); Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). 22 Sep 1986. Contract W-7405-ENG-36. 69p. (CONF-8609234—7). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87008988.

From International collaboration on advanced neutron sources; Villigen, Switzerland (22 Sep 1986).

During the summer of 1985, we replaced the WNR T-shaped target/moderator scheme with the LANSCE split-target/flux-trap-moderator design. The intent of this 'LANSCE upgrade' was to increase (to 12) the number of neutron beam lines serviced simultaneously, and to enhance the target area shielding and target system to accept 200 μA of 800-MeV protons. The four LANSCE moderators consist of three (chilled) water moderators, and a liquid hydrogen (20 K) moderator. The LANSCE target is machinable tungsten.

35492 (LA-UR—87-1253) Power supply design for Hadron Facility. Karady, G.; Kansog, J.; Thiessen, H.A.; Schneider, E. (Los Alamos National Lab., NM (USA); Ebasco Services, Inc., New York (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-870260—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008994.

From International workshop hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Recently, a study investigated the feasibility of building a large 60 GeV, kaon factory accelerator. This paper presents the conceptual design of the magnet power supplies and energy storage system. In this study the following three systems were investigated: (a) power supply using storage generator; (b) power supply using inductive storage device; and (c) resonant power supplies. These systems were analyzed from both technical and economical points of view. It was found that all three systems are feasible and can be built using commercially available components. From a technical point of view, the system using inductive storage is the most advantageous. The resonant power supply is the most economical solution.

35493 (LBL—21738) Operation of the LBL ECR source injection system. Clark, D.J.; Lyneis, C.M. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 16p. (CONF-8610173—16). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009170.

From 11. conference on cyclotrons and their applications; Tokyo, Japan (13 Oct 1986).

The injection system for the LBL 88-Inch Cyclotron ECR source has been in operation since October 1984. It consists of 7 meters of horizontal beam line following the ECR source analyzing magnet, and 4 meters of vertical beam line down the axis of the cyclotron. Beams throughout the cyclotron energy range of 1 to 32 MeV/u, and particles from protons to xenon have been injected and accelerated in the cyclotron on 1st, 3rd, 5th and 7th harmonic modes. A non-scaling mode of operation is used in which a source voltage of about 10 kV is used for all beams. The overall transmission from source analyzing magnet to cyclotron external beam is typically 10%. The reliability and stability of the system has been excellent.

35494 (LBL—22143) New high-dispersion beamlines at the Bevalac for the production, purification and transport of radioactive beams. Krebs, G.F.; Alonso, J.R.; Kalnins, J.; Matsuta, K.; Minamisono, T.; Nojiri, Y.; Sugimoto, K.; Takeyama, K.; Omata, K.; Shida, Y. (Lawrence Berkeley Lab., CA (USA); Osaka Univ., Toyonaka (Japan). Faculty of Science; Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study; Institute of Physical and Chemical Research, Wako, Saitama (Japan); National Lab. for High Energy Physics, Oho, Ibaraki (Japan); Tokyo Univ. (Japan). Faculty of Science). Mar 1987. Contract AC03-76SF00098. 5p. (CONF-870302—109). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008227.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The external particle beam transport area of the Lawrence Berkeley Laboratory's Bevalac was redesigned so that radioactive beams may be more efficiently analyzed and transported. Using a variety of relativistic heavy ions available at the Bevalac, radioactive beams can be formed at the first external focus point of the accelerator by the process of nuclear fragmentation. The large cross-section and small deflection of the projectile fragments leads to high production and delivery efficiency for these beams. The production, purification, and delivery of radioactive beams of /sup 20,21/F and ^{39}Ca are reported.

35495 (LBL—22191) Injection system design for the LBL [Lawrence Berkeley Laboratory] 1-2 GeV synchrotron radiation source. Selph, F.; Jackson, A.; Zisman, M.S. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—157). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009167.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The injection system for the LBL 1 to 2 GeV Synchrotron Radiation Source is designed to provide an electron beam of 400 mA at 1.5 GeV to the storage ring in a filling time of less than 5 minutes. An alternate mode of operation requires that 7.6 mA be delivered to one, or a few rf bunches in the storage ring. To accomplish these tasks, a high intensity electron gun, a 50 MeV electron linac, and a 1.5 GeV booster synchrotron are used. The performance requirements of the injector complex are summarized. The electron gun and subharmonic buncher, linac design, and linac to booster and booster to storage ring transport are discussed as well as the booster synchrotron. (LEW)

35496 (LBL—22273) A high-frequency Schottky detector for use in the Tevatron. Goldberg, D.A.; Barry, W.; Lambertson, G.R.; Voelker, F. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 7p. (CONF-870302—171). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009547.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

A vexing problem associated with detection of Schottky signals from a bunched beam is the presence of the coherent signal, which can be 10 or more orders of magnitude greater than the Schottky signal. However, above the single-bunch cutoff frequency (SBCF), the coherent signal decays rapidly with frequency. To take advantage of this, we have constructed a Schottky detector for the Tevatron doubler to operate at roughly 2 GHz (the Tevatron SBCF is 200 to 300 MHz). To enhance signal power density, we have made the detector a high-Q (>9000) resonant rectangular cavity, which should provide a signal-to-noise-density ratio (S/N) of >10 dB for the Tevatron in the collider mode, and >20 dB in fixed target operation. The TM_{810} and TM_{130} modes, which are made to have slightly different frequencies, provide sensitivity to both vertical and horizontal particle motions. The 2 GHz Schottky signals are down-converted to frequencies below 100 kHz to permit analysis using a FFT spectrum analyzer. The initial installation consists of a single cavity; a second detector will be built which employs a pair of phased cavities to permit discrimination between p's and anti p's. Details of the design of both the cavity and the associated electronics are presented. The cavity is currently undergoing installation at the Tevatron.

35497 (LBL—22274) Pulsers for the induction linac experiment, MBE-4. Gough, D.; Brodzik, D.; Faltens, A.; Pike, C.; Stoker, J. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 6p. (CONF-870302—178). NTIS, PC A02. File Number DE87009552.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The MBE-4 proof-of-principle experiment uses an induction linac to accelerate four Cs+ beams from injection at 200 kV to almost 1MV. When completed in the summer of 1987 it will be 17.2 meters long and have 24 acceleration gaps and 6 diagnostic gaps. Careful tailoring of the accelerating voltage waveforms at each gap is required to accelerate the beam, amplify the current and provide longitudinal focusing. The ideal voltage waveforms required at the first 4 gaps are almost triangular with an amplitude of about 20 kV and an approximate width of 3 μsec, becoming flatter and shorter with an amplitude of 30 kV at subsequent gaps as the beam current increases and the pulse width narrows. These waveforms [1] are shown in Fig. 1. Pulser voltage waveforms at each gap are adjusted in both amplitude and firing time in conjunction with beam experiments to determine the required voltage waveforms of the subsequent pulsers. Existing cores and previous experience with thyratron pulsers provided the basis for the pulsers for the first half of the machine. During this fabrication period, additional cores and spark gap pulsers capable of generating higher voltages than the thyratron pulsers became available and a combination of both types of pulser will be used to complete the apparatus.

35498 (SLAC-PUB—4090) Comparison of SmCo and NdFeB in PM multipoles. Baltay, M.; Hamann, P.; Sattler, W.; Spencer, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Vacuumschmelze G.m.b.H., Hanau (Germany, F.R.)). Sep 1986. Contract AC03-76SF00515. 4p. (CONF-870302—128). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008865.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

We study the use of such compounds in the strong, permanent magnet multipoles required for handling high energy, charged particle beams. We have made a number of $SmCo_5$ multipoles which have been used in a variety of ways, e.g., sextupoles for chromatic correction of the SLAC damping rings and quadrupoles for matching their associated injection and extraction lines. For applications in high radiation areas, we have used VACOMAX 170 thermally stabilized at 80°C. Because our fabrication method uses measured characteristics of individual blocks in isolation, linearity over the operating range of the B-H curve is important. Stronger PM materials or multipole magnets increase the operating range which decreases linearity and increases unwanted harmonics. To study such effects, multipole magnets of VACODYM 370 are being made at different radii to emphasize high field effects which can drive parts of a magnet well into the third quadrant of the B-H curve. The results are compared to calculations based on various assumptions and our previous results for SmCo.

35499 **(SLAC-PUB—4099) Commissioning of the SLC injector.** Sheppard, J.C.; Bambade, P.S.; Clendenin, J.E.; Gearhart, R.A.; Miller, R.H.; Sodja, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1986. Contract AC03-76SF00515. 5p. (CONF-870302—127). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008863.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

For every cycle of the SLC, the injector is required to launch two electron bunches and a single positron bunch into their respective emittance damping rings. Each bunch is to have a population of 7.5 x 10^{10} particles/bunch, an energy of 1.21 GeV, and a full width energy spread of less than 2%. The electron beams are produced from a thermionic cathode, bunched, and accelerated to about 200 MeV. Positrons are injected after electrons at the 200 MeV point. The three bunches, spaced by approximately 60 ns, are subsequently accelerated to the damping ring energy within a single RF pulse. As of September 1986, all of the injector hardware had been installed and tested. Single electron bunches were being produced, stabilized with respect to energy characteristics, and injected into the damping rings. Commissioning of two electron bunch operation is currently in progress. Three bunch running should be commissioned by early 1987 and the SLC injector is expected to be operational by April 1987. This paper will report on the hardware and software developments necessary for the injector. The operational status of the entire system will be discussed.

35500 **(SLAC-PUB—4100) Three bunch energy stabilization for the SLC injector.** Sheppard, J.C.; Almog, I.; Bambade, P.S.; Clendenin, J.E.; Jobe, R.K.; Phinney, N.; Shoaee, H.; Stiening, R.F.; Thompson, K.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Sep 1986. Contract AC03-76SF00515. 5p. (CONF-870302—123). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008870.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

Slow feedback has been developed to control the energy and energy spread of the beams which are injected into the SLC damping rings. Within a single RF pulse, two bunches of electrons and one bunch of positrons are accelerated to an energy of 1.21 GeV in the injector of the SLC. The two electron bunches are deflected into the north damping ring while the positrons are targeted into the south ring. In order to fit into the acceptance of the rings, the composite energy deviation and energy spread of the beams must be less than 2% full width. Control of the beam energy characteristics is accomplished with a set of computer controlled feedback loops which monitor the parameters of the three bunches and make adjustments to the available RF energy, RF phasing, and RF timing. This paper presents an overview of the feedback algorithms and of the special hardware developments, and reports on the operational status of the processes.

35501 **(SLAC-PUB—4204) IKE: An interactive klystron evaluation program for SLAC linear collider klystron performance.** Kleban, S.D.; Koontz, R.F.; Vlieks, A.E. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 3p. (CONF-870302—120). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008873.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

When the new 65 MW klystrons for the SLC were planned, a computer based interlock and data recording system was implemented in the general electronics upgrade. Significant klystron operating parameters are interlocked and displayed in the SLC central control room through the VAX control computer. A program titled "IKE" has been written to record klystron operating data each day, store the data in a database, and provide various sorted operating and statistical information to klystron engineers, and maintenance personnel in the form of terminal listings, bar graphs, and special printed reports. This paper gives an overview of the IKE system, describes its use as a klystron maintenance tool, and explains why it is valuable to klystron engineers.

35502 **(SLAC-PUB—4219) The completed design of the SLC Final Focus System.** Murray, J.J.; Brown, K.L.; Fieguth, T. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—168). NTIS, PC A02. File Number DE87009452.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The design of the SLC Final Focus System has evolved from its initial conceptual design into its final form. This final design is described including a review of the critical decisions influencing the adoption of particular features. The creation of a feasible design has required that these decisions be tempered by practical considerations such as site constraints, correction of optical errors caused by imperfections, and accommodations requested by engineers and particle detector physicists. As this is the first such system to be built, it is hoped that the experience gained will be useful for the design of future systems.

35503 **(SLAC-PUB—4231) Timing stabilization for the SLC electron source.** Clendenin, J.E.; Browne, M.J.; Gearhart, R.A.; Sheppard, J.C.; Sodja, J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Feb 1987. Contract AC03-76SF00515. 4p. (CONF-870302—124). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008869.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

The timing stability required for the SLC electron source is determined by the energy acceptance of the electron damping ring. The jitter requirements for the gun pulse itself are somewhat mitigated by the subsequent bunching process. The desogn of the system by which a gun pulse stability of $\sigma \sim 20$ ps is achieved is described, and experiments to measure the resulting energy stability under various bunching conditions are discussed.

35504 **Operation of a 120-MW ion beam source using an Applied-B/sub θ/ ion diode.** Lockner, T.R.; Poukey, J.W.; Stygar, W.; Humphries S. Jr.; Kraybill, D.M. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **62**: No. 3, 745-753(1 Aug 1987).

The operation of an Applied-B/sub θ/ ion diode has been studied at voltages up to 1.8 MV and diode currents of 250 kA. Peak ion currents up to 80 kA were observed at diode current efficiencies of up to 33% during the 60 ns power pulse. Ion and electron flow patterns have been carefully measured which indicate electron loss at locations far removed from the anode-cathode gap and ion current density enhancement at the inner anode radius due to motion of the cathode electron sheath. Numerical simulations performed with particle-in-cell codes agree well with the experimentally determined diode parameters including electron dynamics and ion and electron fluxes.

35505 **PBFA II, A 100 TW pulsed power driver for the inertial confinement fusion program.** Turman, B.N.; Martin, T.H.; Neau, E.L.; Humphreys, D.R.; Bloomquist, D.D.; Cook, D.L.; Goldstein, S.A.; Schneider, L.X.; McDaniel, D.H.; Wilson, J.M. (Sandia National Labs., Albuquerque, NM 87185). pp 155-161 of Digest of technical papers of the 5th IEEE pulsed power conference. Turchi, P.J.; Rose, M.F. Piscataway, NJ; IEEE Service Center (1985). (CONF-850616—). Contract AC04-76DP00789.

From 5. IEEE pulsed power conference; Washington, DC, USA (10 Jun 1985).

The 100 TW Particle Beam Fusion Accelerator (PBFA II) is well into the procurement and assembly phases, with the first shot scheduled for January 1986. Installation of several major sub-assemblies is underway. The PBFA II output will drive a fast opening switch in the vacuum insulator stack, providing a 30 MV, 15 ns output pulse, which accelerates lithium ions. The ions will focus onto a pelled containing dueterium-tritium, producing fusion energy. Several research areas will be reviewed: low jitter, highly reliable 370 kJ Marx generators; highly synchronized gas switching at 5 MV; efficient water switch operation of 5 MV lines; series-parallel arrangements for increasing voltage or current; and plasma erosion opening switches.

4304 Storage Rings

REFER ALSO TO CITATION(S) 35479, 35483

35506 **Superconducting Super Collider magnet cryostat.** Niemann, R.C.; Craddock, W.W.; Engler, N.H.; Gonczy, J.D.; Nicol, T.H.; Powers, R.J.; Rode, C.H. New York, NY; American Institute of Chemical Engineers (1986). 7p. (CONF-861146—). American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

The proposed Superconducting Super Collider high energy physics research facility will entail one of the major cryogenic system undertakings of the next decade. The two 30 Km diameter accelerator rings contain an integrated system of ≈10,000 superconducting devices that must have low capital cost and operate reliably and efficiently over the lifetime of the machine. The design for the ≈8,000 superconducting dipole magnet cryostats has been developed and evaluated by both component and systems tests. The details of the design are presented along with summaries of the experimental evaluations of the suspension system, insulation, transient phenomena, systems' performance, etc.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 34715, 35548, 35979, 35986

35507 **(AD-A—177937/0/XAB) Satellite observation of atmospheric nuclear gamma radiation.** Letaw, J.R.; Share, G.H.; Kinzer, R.L.; Silberberg, R.; Tsao, C.H. (Severn Communications Corp., Severna Park, MD (USA)). Jan 1987. 32p. NTIS, PC A03/MF A01.

A satellite observation of the spectrum of gamma radiation from the Earth's atmosphere is presented in the energy interval from 300 keV to 8.5 MeV. The data were accumulated by the Gamma Ray Spectrometer on the Solar Maximum Mission over three and one-half years. The excellent statistical accuracy of the data set allows 20 atmosphere line features to be distinguished. All observed lines are consistent with production by secondary-neutron interactions with atmospheric 14N and 16O. Although no evidence was found for other production mechanisms, direct excitation or spallation by primary protons cannot be ruled out as a source of atmospheric line radiation. Line intensities are in rough agreement with theoretical models which are presently limited by cross section availability. The intensity and spectrum of scattered photons at energies below the 0.511-MeV line can be accounted for by Compton scattering in a 21 g/sq cm slab of atmosphere.

35508 **(AD-A—178059/2/XAB) Flash x-ray dosimetry. Final report, October 1985-September 1986.** Heimbach, C.R. (Army Combat Systems Test Activity (Prov.), Aberdeen Proving Ground, MD (USA)). Dec 1986. 79p. (USACSTA—6442). NTIS, PC A05/MF A01.

A methodology investigation of dosimetry techniques was developed and calibrated to provide radiation monitors in a combined fast-burst reactor/flash x-ray environment. These techniques include improved neutron-fluence dosimetry, development of suitable gamma-ray total-dose monitors, and a monitor of the dose rate versus time profile.

35509 **(AD-A—178336/4/XAB) Ionization-chamber intercomparison in mixed neutron and gamma-ray radiation fields by National Bureau of Standards and Armed Forces Radiobiology Research Institute. Technical report.** Dooley, M.; Goodman, L.J.; Zeman, G.H.; Schwartz, R.B.; Eisenhauer, C.M. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1986. 48p. (AFRRI-TR—86-3). NTIS, PC A03/MF A01.

This report describes a dosimetry intercomparison conducted between the Armed Forces Radiobiology Research Institute (AFRRI) and the National Bureau of Standards (NBS). The project was undertaken as part of an overall program to validate the reliability and credibility of the neutron dosimetry system used with the AFRRI TRIGA reactor in support of radiobiology research. The intercomparison included adsorbed dose measurements with ionization chambers by the AFRRI Radiological Physics Division and the NBS Nuclear Radiation Division. Measurements were made at the NBS californium-252 facility using unmoderated and heavy-water-moderated configurations. At the AFRRI TRIGA reactor, measurements were done in four radiation fields, including unshielded, lead-shielded, and water-shielded configurations. All data were collected during the period July 1983 to March 1984. The agreement between results obtained by the two groups was good in the NBS californium-252 fields and excellent in the AFRRI reactor fields. Through the course of the study, the calibration procedures used at AFRRI were validated, and valuable data were collected on ionization chamber characteristics and the spatial variation of tissue kerma rates in the AFRRI reactor exposure room. This report includes descriptions of the radiation sources, dosimetry methods, dosimetry result, and special dosimetry problems encountered during the work.

35510 **(AD-A—179051/8/XAB) Reference dosimetry for 1986 NATO battlefield dosimetry intercomparison at Army Pulsed Radiation Facility. Technical report.** Dooley, M.; Eagleson, D.M.; Mohaupt, T.H.; Kazi, A.H.; Zeman, G.H. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Dec 1986. 26p. (AFRRI-TR—86-4). NTIS, PC A03/MF A01.

This report contains the methods and results of dosimetry measurements made by the Radiological Physics Division, Armed Forces Radiobiology Research Institute, at the Army Pulsed Radiation Facility. The purpose of this work was to benchmark the radiation fields for a NATO intercomparison study of personnel dosimeters designed for use on a nuclear battlefield. Primary measurements were made, with the reactor at a steady-state power level, using a pair of TE-TE and Mg-Ar ion chambers and sulfur-activation pellets. These provided a dose-per-fluence monitor factor for use in the pulsed irradiations of the intercomparison.

35511 **(DESY-L-Trans—309) New method for radiation detection in instruments based on microchannel plates.** Ammosov, V.V.; Bolozdynya, A.I.; Kubantsev, M.A.; Lebedenko, V.N.; Sudorov, A.L. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Jul 1986. 12p. NTIS, PC E07; Available from NTIS as TIB/B86-11051.

Translated from Russian. Published as preprint ITEF--48, Moscow, 1986.

The authors used as an example the recording of ultraviolet radiation of a pulsed laser. They proved that it is possible to obtain information on coordinates directly from microchannel plates (MCPs) as storage matrix in radiation detectors. They used the television channel: electronic-optical vidicon system - television transmission chamber - telemonitor as read-out system and for information selection.

35512 **(DOE/ER/40315—140) The NA36 time projection chamber: An interim report on a TPC designed for a relativistic heavy ion experiment.** Diebold, G.E. (Carnegie-Mellon Univ., Pittsburgh, PA (USA)). [1987]. Contract FG02-87ER40315. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010864.

Since its conception in the early 1970s, the Time Projection Chamber (TPC) has found application in several areas of particle physics ranging from e^+e^- collider experiments to rare decay studies of lepton nonconservation. A new and promising area of application for the TPC is the study of relativistic heavy ion collisions (RHIC). Presented here is an interim report on the first TPC for this field of physics, the NA36 TPC, being developed by Berkeley (LBL) for RHIC at the CERN SPS. Emphasis is placed on the operational and design considerations implemented to optimize the performance of the NA36 TPC in the study of central rapidity

strange baryons produced in RHIC. The NA36 TPC volume is rectangular with an endcap area 0.5 m x 1.0 m and a maximum drift distance of 0.5 m. The drift volume is filled with Ar-CH_4 (9%) at one atmosphere. A total of 6400 channels of time digitizing electronics instrument 66% of the endcap in a wedge shaped area matched to fixed target kinematics. 6 refs., 5 figs.

35513 (RFP—3990, pp 33-42) **Field calibration methods for personnel neutron dosimeters.** Ahmad, S.J.; Langsted, J.M. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

An attempt is made to develop field calibration methods for personnel neutron dosimeters using a Multisphere Neutron Detection System and Tissue Equivalent Proportional Counters. Four detectors were investigated, with five source configurations. Dose equivalent rates were then estimated. Future work will include finalizing the operating procedures and determining work area-specific personnel dosimeter calibration factors.

35514 (UCRL—95780) **Neutron spectra evaluation obtained from the track-size distribution on electrochemically etched CR-39 foils.** Hankins, D.E.; Westermark, J. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 17p. (CONF-870525—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010271.

From Workshop on development of personal neutron dosimeters based on track etch detectors; Harwell, UK (12 May 1987).

We are studying the relationship between neutron energy and track-size distribution on electrochemically etched CR-39 foils using a two-stage etching procedure. Although the electrochemical etching process alters the track size, we now find that the track diameter is related to the neutron energy even after the second stage (blowup) is completed. This relationship is complex, being effected by the etching parameters, including oven temperature, etching high voltage, and etching time. Current studies are directed at establishing the effect of each of these parameters on the track-size distribution and at determining an optimal etching procedure for neutron spectra evaluation. If neutron spectral information can be determined from the track-size distribution, dose can be calculated directly from the neutron fluence and spectrum.

35515 (UCRL—96590) **Nuclear physics at PEP: Recent results using the Time Projection Chamber.** Melnikoff, S.O. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 10p. (CONF-870165—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009575.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

A preliminary result on Bose-Einstein correlations is reported using the PEP-4 Time Projection Chamber facility. The data, from scattering 14.5 GeV electrons on nuclei, was taken at the Stanford Linear Accelerator Center positron-electron (PEP) storage ring. Bose-Einstein (BE) correlations were measured from events having identified like-sign pion pairs. The particle identification and tracking capability of the Time Projection Chamber (TPC) was used to select like-sign pion pair events. The resulting correlation function for the data was fitted to a gaussian form $R(q) = 1 + \lambda \exp(-q^2\sigma^2)$ where q is the relative four-momentum difference of the pions. The fitted value to the chaoticity is $\lambda = 0.37 +- 0.19$ and $\sigma = 1.37 +- 0.41$ fermi. This result agrees with that from e^+e^- annihilation data taken with the TPC. The operation of the TPC and the analysis of the data is explained. The feasibility of similar detectors for doing high energy electron scattering on nuclei at PEP is briefly discussed. 9 refs., 8 figs.

35516 **Instrumentation research and development in DOE health physics programs.** Selby, J.M.; Vallario, E.J.; Swinth, K.L. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 3, 684-689(Jun 1987). Contract AC06-76RL01830.

Planning and control of exposure to ionizing radiation require the use of accurate, reliable instrumentation to establish dose rates, indicate high exposure rate areas, and control the spread of contamination. The Radiological Controls Division of the U.S. Department of Energy (DOE) operates several programs under the technical direction of DOE's lead laboratory in health physics, the Pacific Northwest Laboratory. These programs involve the evaluation and development of instruments to measure dose rates.

35517 **Ultrafast neutron detector.** Wang, C.L. (to Dept. of Energy, Washington, DC). US Patent 4,667,107. 19 May 1987. Filed date 19 Jun 1985. vp.

This patent describes a neutron detector, for measuring neutrons leaving a source that is approximately a point source. The detector comprising: a circularly curved two-conductor traveling-wave transmission line, comprising a first conductor and a second conductor; means for applying a reverse bias to the conductors of the transmission line; means for launching an electric field pulse along the transmission line; a circularly curved uranium cathode, comprising part of the first conductor of the transmission line, with the transmission line being circularly curved along the general locus of the uranium cathode, and with the uranium cathode being adapted to be positioned everywhere approximately equidistant from the source.

35518 **Use of a high density lead glass tubing projection chamber in positron emission tomography and in high energy physics.** Conti, M.; Del Guerra, A.; Schwartz, G.; Habel, R.; Mulera, T.; Perez-Mendez, V. (Pisa Univ., Italy; Istituto Nazionale di Fisica Nucleare, Pisa, Italy; ENEA, Frascati, Italy; Lawrence Berkeley Lab., CA). *Nuclear Instruments and Methods in Physics Research;* **255**: No. 1/2, 207-212(15 Mar 1987). (CONF-850925—).

From 3. international symposium on radiation physics; Ferrara, Italy (30 Sep 1985).

Also published as report LBL—20491; CONF—850925-3.

We describe the principle of operation of a high density projection chamber, in which the converter/radiator and drift field shaping structures are combined in the form of high density (5-6 g/cm^3) lead glass tubing. The main applications of this type of detector to medical physics (positron emission tomography) and high energy physics (electromagnetic calorimetry) are discussed.

35519 **Radiation dosimetry through spectral definition.** Dowdy, E.J.; Moss, C.E.; Robba, A.A.; Evans, A.E.; Lucas, M.C.; Shunk, E.R.; Goulding, C.A. (Los Alamos National Lab., NM). *Nuclear Instruments and Methods in Physics Research;* **255**: No. 1/2, 317-325(15 Mar 1987). (CONF-850925—).

From 3. international symposium on radiation physics; Ferrara, Italy (30 Sep 1985).

We have developed a fieldable instrumentation system for determining from measured flux spectra, both the neutron and gamma ray dose rate distributions associated with radioactive sources. This system includes the sensors, the computer-based data acquisition and analysis hardware, and the requisite software for unfolding the sensor response functions to obtain the flux spectra, and for folding the resultant flux spectra with appropriate flux spectrum-to-dose conversion factors. We use bismuth germanate scintillators that have experimentally measured and analytically interpolated response functions to determine the gamma ray flux spectra, and a suite of neutron sensors, based on proton recoil and ^{3}He capture, to determine the neutron flux spectra. In addition, gamma ray peak identification is done using HPGe sensors. We describe the equipment and procedures and present some recent results.

35520 **Response of A 24cm x 36cm NaI(Tl) spectrometer to γ rays between 50 and 300 MeV.** Dowell, D.H.; Ziegler, W.P.; Sandorfi, A.M.; Ziegler, B.; Schoch, B. (Brookhaven National Lab., Upton, NY; Max-Planck-Institut fuer Chemie, Otto-Hahn-Institut, Mainz, Germany, F.R.; Mainz Univ., Germany, F.R.). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **254**: No. 3, 570-577(1 Mar 1987).

The high-energy gamma-ray response function of a 24 cm diameter x 36 cm long NaI(Tl) detector surrounded by a 10 cm thick plastic anticoincidence shield was measured using a tagged-brems-

strahlung beam. Incident electrons of 300 and 350 MeV radiated in a 55 μm aluminum foil and were analyzed in a 180° magnetic spectrometer to produce gamma rays at 50, 100, 200, and 300 MeV. For a 2.5 cm diameter collimation of the gamma ray beam, the NaI(Tl) resolution was found to be 5.5% fwhm at E/sub γ/=50 MeV, increasing to 6.3% fwhm at E/sub γ/=300 MeV. The energy resolution significantly improved by accepting only those events which were not coincident with the plastic shield. At E/sub γ/=300 MeV, a low plastic threshold gave a resolution of 2.7% and reduced the NaI(Tl) efficiency to 17%. These measurements are compared with the results from a Monte Carlo calculation using the electron generating shower (EGS) code.

35521 **Impact of natural radioactivity in solder on low background experiments.** Brodzinski, R.L.; Reeves, J.H.; Avignone, F.T.; Miley, H.S. (Battelle Pacific Northwest Labs., Richland, WA; South Carolina Univ., Columbia). *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment;* **254**: No. 2, 472-473(15 Feb 1987).

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 35417, 35421

35522 **(AD-A—177873/7/XAB) Comparison of CREME (cosmic-ray effects on microelectronics) model LET (linear energy transfer) spaceflight dosimetry data.** Letaw, J.R.; Adams, J.H. (Severn Communications Corp., Severna Park, MD (USA)). 15 Jul 1986. 26p. (SCC—86-01). NTIS, PC A03/MF A01.

The galactic cosmic radiation (GCR) component of space radiation is the dominant cause of single-event phenomena in microelectronic circuits when Earth's magnetic shielding is low. Spaceflights outside the magnetosphere and in high inclination orbits are examples of such circumstances. In high-inclination orbits, low-energy (high LET) particles are transmitted through the field only at extreme latitudes, but can dominate the orbit-averaged dose. GCR is an important part of the radiation dose to astronauts under the same conditions. As a test of the CREME environmental model and particle transport codes used to estimate single event upsets, we have compiled existing measurements of HZE doses were compiled where GCR is expected to be important: Apollo 16 and 17, Skylab, Apollo Soyuz Test Project, and Kosmos 782. The LET spectra, due to direct ionization from GCR, for each of these missions has been estimated. The resulting comparisons with data validate the CREME model predictions of high-LET galactic cosmic-ray fluxes to within a factor of two. Some systematic differences between the model and data are identified.

35523 **(SAND—87-0220C) Radiation-tolerant, sidewall-hardened SOI/MOS transistors.** Tsao, S.S.; Fleetwood, D.M.; Weaver, H.T.; Pfeiffer, L.; Celler, G.K. (Sandia National Labs., Albuquerque, NM (USA); Bell Labs., Murray Hill, NJ (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870724—13). NTIS, PC A02. File Number DE87006716.

From 24. annual conference on nuclear and space radiation in electronics; Snowmass, CO, USA (28 Jul 1987).

The effects of total-dose radiation have been investigated for sidewall-hardened n-channel MOS transistors fabricated in zone-melt recrystallized (ZMR) and oxygen-implanted SOI films. Subthreshold leakage currents and threshold voltage shifts remained acceptably low for the superior ZMR devices at doses greater than 1 Mrad (SiO_2).

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 35271, 35413, 35453, 35763, 35917

35524 **(AD-A—178825/6/XAB) Tandem Fourier-transform mass spectrometry.** McLafferty, F.W.; Amster, I.J. (Cornell Univ., Ithaca, NY (USA). Dept. of Chemistry). 1986. 8p. NTIS, PC A02/MF A01.

Pub. in International Jnl. of Mass Spectrometry and Ion Processes, Vol, 72, 85-91(1986).

Advantages of the Fourier-transform mass spectrometer for tandem mass spectrometry (MS/MS) include the ability to perform consecutive mass separations (even MS superscript) in its one analyzer cell, unusually high resolution (1,000,000 at m/z 300) which is independent of ion kinetic energy, simultaneous (multichannel) detection of nearly all masses, sub-picomole sensitivity, high mass range (> 16000 daltons) without detector limitations, collisionally activated dissociation of ions of energies of volts to kilovolts with efficient daughter-ion trapping, and flexible capabilities for ion/molecule reactions and ion photodissociation.

35525 **(HEDL—7648) The effect of irradiation of the thermal conductivity of lithium ceramics.** Ethridge, J.L.; Baker, D.E. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76FF02170. 5p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010417.

An apparatus for measuring the thermal conductivity of irradiated lithium ceramics to 900°C was designed, fabricated, and tested. Special attention was necessary in order to accommodate tritium released during the high-temperature measurements.

35526 **(LBL—23387) Spectroscopic information from high resolution images.** Gronsky, R. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 33p. (CONF-860829—42). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011098.

From Annual joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society; Albuquerque, NM, USA (10 Aug 1986).

Phase contrast images recorded under proper conditions of specimen thickness and orientation, as well as microscope alignment, focus and correction of astigmatism, yield a direct indication of atom positions in the sample. Confidence in the interpretation of such images is fostered by comparison with computer simulated images that utilize models of the actual specimen structure and a full account of dynamical scattering. Such images provide the capability for extracting spectroscopic information at the atomic scale. This study critically examines the capabilities and limitations of this technique, including its potential for future development.

35527 **(SAND—87-0154C) Recent developments in piezoelectric polymer stress gauges.** Reed, R.P. (Sandia National Labs., Albuquerque, NM (USA)). 15 May 1987. Contract AC04-76DP00789. 17p. (CONF-870692—2). NTIS, PC A02. File Number DE87010037.

From 14. transducer workshop; Colorado Springs, CO, USA (16 Jun 1987).

Piezoelectric polymer stress gauges of polyvinylidene fluoride (PVF2) now allow the accurate measurement of shock and stress waves of more than 200 GPa amplitude and time resolution generally of tens of ns but in special circumstances of a few ns. Among the many benefits of this gauge type are fidelity, high sensitivity, small size, simple signal conditioning, design versatility, flexibility, and adaptability to use in the radiation environment. Reliability and accuracy of PVF2 measurement transducers has been made possible only by the availability of well controlled material and development of special procedures for electrically poling the material. This paper describes the measurement principle and application of the piezoelectric polymer material as well as some benefits and limitations of this class of stress gauge that is under development at Sandia National Laboratories. 48 refs.

35528 **(SAND—87-0716C) Acoustic wave devices for sensing in liquids.** Martin, S.J.; Ricco, A.J.; Hughes, R.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-870676—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007679.

From 4. international conference on solid-state sensors and actuators; Tokyo, Japan (2 Jun 1987).

Horizontally polarized shear waves (HPSWs) have been used for acoustic sensing of liquid viscosity and for measuring submonolayer mass changes accompanying electrode reactions. HPSWs are excited on a piezoelectric substrate using interdigital

transducers in much the same fashion as the Rayleigh waves used in surface acoustic wave (SAW) sensors. HPSW sensors are shown to have several advantages compared to SAW devices and bulk crystal oscillators for liquid sensing.

35529 **(UCID—21070) Velocimetry of fast surfaces at LLNL using Fabry-Perot interferometry.** McMillan, C.F.; Goosman, D.R.; Parker, N.L.; Steinmetz, L.L.; Chau, H.H.; Huen, T.; Whipkey, R.K.; Perry, S.J. (Lawrence Livermore National Lab., CA (USA)). 20 May 1987. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87010550.

This report describes the use of the Fabry-Perot interferometer in the fringe mode to measure velocities of fast moving reflecting surfaces. The Doppler shift theory applicable to this situation is described. Formulae are derived for the analysis of the effects of shocked, dispersive, moving transparent media on velocity measurements, including expressions for the velocity of light in a moving medium with moving boundaries. The Fabry-Perot method is compared with other techniques such as VISAR interferometry. A standard configuration is described in detail. Methods of alignment, calibration, and operation are included. Several methods of analysis are compared. (JDH)

35530 **(UCRL—92403) Subnanosecond spectroscopy using stripline microchannel plates and Reticon 1024SF linear arrays.** O'Brien, C.R.; Zumstein, J.M.; Eckart, M.J.; McGee, M.E.; Schulte, H.; Edwards, W.R. (Lawrence Livermore National Lab., CA (USA)). Sep 1985. Contract W-7405-ENG-48. 9p. (CONF-8511123—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008757.

From 2. international technical symposium on optical and electro-optical applied science and engineering; Cannes, France (25 Nov 1985).

A new approach to subnanosecond spectroscopy using a stripline microchannel plate as an optical gate for a stack of seven linear arrays is discussed. This new technique allows seven subnanosecond time slices of the spectrum to be read out on a single cable with a frame time of 1 ms. Each of the seven time slices is capable of 500 channels of spectral data, with each channel having a dynamic range of 1000/1.

35531 **(UCRL—93856) The accurate measurement of small rotations by modulating polarization.** Robinson, W.L.; Gillespie, C.H. (Lawrence Livermore National Lab., CA (USA)). Jan 1986. Contract W-7405-ENG-48. 19p. (CONF-860117—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009597.

From Los Angeles symposium and exhibition on optical and electro-optical engineering; Los Angeles, CA, USA (19 Jan 1986).

An instrument developed to accurately measure small rotations (twist about an optical axis) uses a Faraday rotator to modulate the polarization of a HeNe laser beam. Twist sensors located in the beam path consist of a calcite polarizer (analyzer), a silicon detector and associated electronics. The sensors measure relative changes of the sensor analyzer and the null position of the modulated source beam. Reference measurements of the laser intensity and beam modulation are made to avoid accurately characterizing the modulation amplitude. This instrument has a senisitivity of 0.2 microradians at 5 Hz bandwidths over a 17.5 milliradians measuring range. This is accomplished by controlling the beam wander, reducing the laser divergence, and utilizing synchronous detection.

35532 **(UCRL—93934) Increasing sensitivity of a deflection measurement system.** Teruya, A.T. (Lawrence Livermore National Lab., CA (USA)). Jan 1986. Contract W-7405-ENG-48. 9p. (CONF-860117—18). NTIS, PC A02. File Number DE87009605.

From Los Angeles symposium and exhibition on optical and electro-optical engineering; Los Angeles, CA, USA (19 Jan 1986).

Synchronous demodulation was applied to the Laser Optical Line of Sight system (LOLOS) used to measure deflections of a canister used in underground testing. The purpose of this was to achieve greater sensitivity and resolution than that found in the original system. Electronics and optical equipment were built or acquired to evaluate the concept. Under laboratory conditions sensitivity to lateral and angular displacements were improved by more than an order of magnitude.

35533 **(UCRL—95782) Use a single FM microwave link for two black-and-white cameras.** Rufer, R.P. (Lawrence Livermore National Lab., CA (USA)). 15 Jul 1987. Contract W-7405-ENG-48. 4p. (CONF-870743—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009583.

From Carnahan conference on security technology; Atlanta, GA, USA (15 Jul 1987).

Many microwave systems today transmit high-quality video signals. Some of these systems are outstanding in quality, with technical performance significantly better than that needed for the application. If this is the case in your installed link, you may be able to use this "excess" performance to your advantage and add another independent video channel. You can probably do this without any modification to the operating license, as long as you don't exceed the bandwidth limitations. This approach effectively conserves valuable space in the radio frequency spectrum.

35534 **(UCRL—96131) Enclosed space detection: A model-based approach.** Candy, J.V.; Followill, F.E. (Lawrence Livermore National Lab., CA (USA)). Feb 1987. Contract W-7405-ENG-48. 8p. (CONF-870742—1). NTIS, PC A02. File Number DE87007331.

From 10. IFAC world congress on automatic control; Munich, F.R. Germany (27 Jul 1987).

The enclosed space detection problem is concerned with the detection of an individual or individuals present in an areas that is not accessible visually but only through sensors deployed about the perimeter under investigation. Devices developed to detect these individuals using only sensor information are called enclosed space detectors. In this paper we develop a technique to enhance signal estimates which will eventually be used to solve the enclosed space detection problem. We develop a model-based approach that leads to a multichannel poise canceling/deconvolution solution.

35535 **(UCRL—96594) Preliminary radiation hardness testing of $LiNbO_3$:Ti optical directional coupler modulators operating at 810 nm.** Roeske, F.; Jander, D.R.; Lancaster, G.D.; Lowry, M.E.; McWright, G.M.; Peterson, R.T.; Tindall, W.E. (Lawrence Livermore National Lab., CA (USA)). 1 May 1987. Contract W-7405-ENG-48. 9p. (CONF-870584—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010336.

From Technical symposium southeast on optics, electro-optics and sensors; Orlando, FL, USA (17 May 1987).

Integrated optics have the potential to replace conventional electronics in many instrumentation applications; in many cases the integrated-optics approach is the only one that will achieve the necessary bandwidth and information-density goals. Thus far, little work has been done to address the prompt hardness of these devices to intense ionizing-radiation fields. Preliminary data is presented on the response of optical directional coupler modulators (ODCMs) to radiation from a Febetron. The Febetron produces energetic electrons in the 300 to 700 keV range in ~3-ns FWHM pulses, with a maximum dose rate of ~1014 rad/s. The operation of the ODCM is monitored during and promptly after the Febetron pulse impinges the device. Long-term effects are also monitored. These data are analyzed with respect to the operation of such devices in a harsh, ionizing-radiation environment.

35536 **(Y/DK—543) Surface characterization using automated stereo analysis and fractals.** Thompson, K.A. (Oak Ridge Y-12 Plant, TN (USA)). 30 Jan 1987. Contract AC05-84OS21400. 9p. (CONF-870725—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87006040.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

This is an initial report of an investigation to determine the practicality of using minicomputers for automated interpretation of stereo pairs. The procedure involves the use of autocorrelation procedures to match features from the stereo pairs, determine the height of the feature, and repeat for the rest of the image. This is a time consuming process, requiring some simplifying algorithms to limit the area of autocorrelation and possibly the method of auto-

correlation. Once topography has been determined, a method is needed to analytically determine the surface roughness, one possibility being the determination of the fractal dimension, if the surface is fractal. This fractality can then be used as a characterization index to compare to other materials or to cross correlate with other experimental techniques.

35537 **Precision capillary viscometer.** Dhadwal, H.S.; Chu, B.; Wang, Z.; Kocka, M.; Blumrich, M. (Department of Electrical Engineering, State University of New York at Stony Brook, Stony Brook, New York 11794-2350). *Review of Scientific Instruments;* **58**: No. 8, 1494-1498(Aug 1987).

A novel precision capillary viscometer which has a time resolution of +- 0.001 s is reported. The viscometer has been utilized to demonstrate that estimates of intrinsic viscosity (to within 3% of the infinite dilution value for polystyrene in benzene) can now be made, over a wide range of polymer molecular weights, for solutions from a single polymer concentration.

35538 **High-sensitivity laser probe for photothermal measurements.** Fanton, J.T.; Kino, G.S. (E. L. Ginzton Laboratory, W. W. Hansen Laboratories, Stanford University, Stanford, California 94305). *Applied Physics Letters;* **51**: No. 2, 66-68(13 Jul 1987).

A high-sensitivity interferometric laser probe has been developed to detect thermally generated surface displacements. Shot-noise-limited detection has been achieved with the use of inexpensive semiconductor lasers.

35539 **Computer aided engineering methods for implementing the Fastbus standard.** Downing, R.W.; Pregernig, L.; Simaitis, V.J. (Center for Supercomputing Research and Development, 104 South Wright Street, Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 3, 690-691(Jun 1987).

In this paper, we discuss the benefits of using Computer Aided Engineering (CAE) methods for implementing a bus standard (Fastbus, ANSI/IEEE Std 960). The authors describe the CAE methods, how standard design implementations and reference models complement CAE tools to form an integrated engineering environment, and they propose to use these methods for future standard developments.

35540 **A virtual Fastbus master module.** Downing, R.W.; Lesny, D.D.; Pregernig, L.; Willwerth, T.W. (Univ. of Illinois at Urbana - Champaign, 1110 West Green Street, Urbana, IL 61801). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 3, 692-694(Jun 1987).

The "Virtual Fastbus Master" is a behavioral model of a general purpose Fastbus master module. In this paper, the authors describe the functions of the model, the behavioral modeling technique and the application of the model. Finally, they discuss some conclusions from this application of behavioral modeling.

35541 **Compensated vibrating optical fiber pressure measuring device.** Fasching, G.E.; Goff, D.R. (to Dept. of Energy, Washington, DC). US Patent 4,667,097. 19 May 1987. Filed date 30 Dec 1985. vp.

A pressure transducer system is described comprising: a support structure; a flexible diaphragm mounted in the support structure to flex in proportion to a differential pressure applied across the diaphragm; an optical fiber connected at points intermediate the ends thereof to the diaphragm and the support structure to form first and second tensioned segments of the optical fiber which are mounted at different degrees of tension so that they vibrate at different natural frequencies when excited. The first segment is attached to the diaphragm at a point such that flexing of the diaphragm changes the tension of the first segment thereby changing its natural resonant frequency. The second segment is attached to the diaphragm at a point such that there is substantially no change in tension during flexing of the diaphragm.

35542 **Instrument review: performance of the Applescope system in laboratory signal collection and averaging.** Rico, G.; Vandiver, J.V.; Leasure, C.S.; Eiceman, G.A. (New Mexico State Univ., Las Cruces). *Analytical Instrumentation (New York);* **13**: No. 3-4, 289-303(1985). Contract AS04-83ER60184.

Effects of pulse width using external triggering on performance of modified Apple IIe computer were investigated. Regular synchronous collection of signal using digital signal averaging with commercially available hardware and software (Applescope/sup R/) was dependent upon characteristics of external triggering including pulse width. Minimum width of trigger pulses for acceptable performance was determined to be a function of user-specified time base and was thoroughly characterized. Frequency response as a function of signal amplitude was also characterized. 6 references, 5 figures.

35543 **Automated dual-wavelength spectrophotometer optimized for phytochrome assay.** Pratt, L.H.; Wampler, J.E.; Rich, E.S. Jr. (Univ. of Georgia, Athens). *Analytical Instrumentation (New York);* **13**: No. 3-4, 269-287(1985).

A microcomputer-controlled dual-wavelength spectrophotometer suitable for automated phytochrome assay is described. The optomechanical unit provides for sequential irradiation of the sample by the two measuring wavelengths with intervening dark intervals and for actinic irradiation to interconvert phytochrome between its two forms. Photomultiplier current is amplified, converted to a digital value and transferred into the computer using a custom-designed IEEE-488 bus interface. The microcomputer calculates mathematically both absorbance and absorbance difference values with dynamic correction for photomultiplier dark current. In addition, the computer controls the operating parameters of the spectrophotometer via a separate interface. These parameters include control of the durations of measuring and actinic irradiation intervals and their sequence. 14 references, 4 figures.

35544 **Signal generator for diagnosing chromatographic and mass spectrometric data systems.** Rico, G.; Leasure, C.S.; Vandiver, V.J.; Eiceman, G.A. (New Mexico State Univ., Las Cruces). *Analytical Instrumentation (New York);* **14**: No. 1, 77-95(1985). Contract AS04-83ER60184.

An electronic test circuit has been designed, constructed and characterized for production of signals which have peak shapes and widths similar to those obtained in gas chromatography, mass spectrometry, and ion mobility spectrometry. Operation of the circuit is based on operational amplifiers and monostable multivibrators. In this circuit design, variables including peak height, peak width, retention times, and number of peaks in a signal can be independently controlled by the analyst. Both repetitive and single sweep signals may be generated with amplitudes from 0.5 to 18 V and with peak widths from 1 nsec. to 20 minutes. Behavior in each major section of the circuit has been characterized and limitations in signal parameters were defined. The circuit was applied to a computer-based digital signal averager and a reporting integrator to demonstrate flexibility and usefulness.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 35888

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

REFER ALSO TO CITATION(S) 35894

35545 (BNL—39542, pp 51) **Implementation of perfluorocarbon vapor tagging of electric blasting caps.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Previous studies at Brookhaven National Laboratory have developed a technique for tagging electric blasting caps with a volatile perfluorocarbon gas which will make it possible to detect

explosives prior to detonation. The Federal Aviation Administration has entered into an agreement with the Institute for Makers of Explosives in order to explore the feasibility of implementing this vapor tagging technique, with Brookhaven providing the technical support.

35546 **(LA—11010-MS) Los Alamos National Laboratory explosives orientation course: Sensitivity and sensitivity tests.** Smith, L.C. (Los Alamos National Lab., NM (USA)). Jul 1987. Contract W-7405-ENG-36. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011261.

The difficulties inherent in the evaluation of the safety of an explosive, and methods used to measure its sensitivity under various conditions of interest, are described and illustrated, with emphasis on procedures used at the Los Alamos National Laboratory. The principal theme of the discussion is that the word sensitivity designates not a well-defined property of an explosive, but, rather, a complex pattern of behavior. The tests described explore the response of an explosive to impact, friction, spark, and shock, and ultimately its behavior under realistic conditions of use. Results are given for a number of explosives of current interest. The report is a modified version of the script used in one of the videotapes in the Los Alamos series on explosives. 21 figs., 9 tabs.

35547 **(UCRL—53786) Projectile penetration into concrete with an inline hole.** Folsom, E.N. Jr. (Lawrence Livermore National Lab., CA (USA)). Jun 1987. Contract W-7405-ENG-48. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010852.

This study is an experimental and analytical investigation of projectile penetration into concrete with an inline hole. An experimentally verified equation of projectile penetration into concrete with an inline hole is presented. Velocity varied from 91 to 401 m/s, and hole/projectile diameter ratio d/D varied from 0 to 0.969. Projectile diameters of 2.20 and 8.86 were used. The standard deviation of the penetration was 9% when the penetration as derived from the equation was compared to the experimental penetration. Experiments showed that projectile penetration depth was dependent on velocity to the 1.5 power, which was the same as a previously published relationship for projectile penetration into concrete without a hole. A finite-element program was used to gain an understanding of the penetration mechanics for the experiments with a projectile diameter of 8.86 cm. Finite-element-calculated penetration for the case without a hole (d/D = O) was 23% low, because strain softening (decrease in strength at high strain) and concrete crater ejecta were not modeled. Finite-element-calculated penetration for a projectile with a velocity of 355 m/s was 22% high, possibly due to strain-rate effects. The relative importance on projectile penetration of concrete dynamic/static strength, equation of state, bulk unloading modulus, coefficient of friction, and finite-element mesh resolution change with the d/D ratio. Projectile penetration for the case of a large hole (d/D = 0.969) was particularly sensitive to the coefficient of friction, leading to an estimate of 0.024 +- 0.012 for the high-velocity concrete coefficient of friction. Projectile penetration into a geologic material with a large hole (d/D $\geq$ 0.97 and $<$ 1.0) and accompanying finite-element analysis of the data can lend itself to the approximation of high-velocity friction coefficients for geologic materials. 29 refs., 10 figs., 2 tabs.

35548 **(UCRL—93074) Radiographic x-ray flux monitoring during explosive experiments by copper activation.** Goosman, D.R. (Lawrence Livermore National Lab., CA (USA)). 28 Jan 1986. Contract W-7405-ENG-48. 10p. (CONF-860950—3). NTIS, PC A02. File Number DE87008742.

From 17. international congress on high speed photography and photonics; Pretoria, South Africa (1 Sep 1986).

During radiographic experiments involving explosives, it is valuable to have a method of monitoring the x-ray flux ratio between the dynamic experiment and an x-ray taken of a static object for comparison. The standard method of monitoring with thermoluminescent detectors suffers the disadvantages of being sensitive to temperature, shock, uv radiation, cleanliness and saturation. A flux monitoring system is being studied which is not subject to any of the above disadvantages and is based upon the 63Cu(photon,n)62Cu reaction. The 62Cu has a 10 min half life and is counted by a nuclear pulse counting system within a few minutes of an explosive test. 170 microcoulomb of 19.3 MeV electrons hitting 1.18 mm of Ta produces x-rays which illuminate a 0.8mm thick by 1.6 cm diameter Cu disk placed 46 cm from the Ta. The activated Cu is placed in a counting system with a window between 400 to 600 keV and produces about 42,500 counts in the first 100 sec. counting period. Less than 0.2% of the initial activity is due to other reactions. Photo-induced neutrons in Be parts of the system are shown to produce a negligible effect in the Cu. The main disadvantage of the Cu activation is its sensitivity to electron energy. Monte-Carlo calculations of the excitation function for our accelerator are shown, along with excitation functions for three other configurations.

35549 **(UCRL—95507) Exploding bridge wire initiation of high explosives.** Frank, A.M. (Lawrence Livermore National Lab., CA (USA)). 1986. Contract W-7405-ENG-48. 21p. (CONF-8610286—1-Summ.). NTIS, PC A02. File Number DE87010872.

From 11. annual joint firing systems conference; Albuquerque, NM, USA (15 Oct 1986).

We are establishing a laboratory for the microscopic examination of exploding bridge wire (EBR) initiation of high explosives. In particular we wish to examine the partition of energy of the EBW and its mechanism(s) for transfer to high explosives (HE). We are using recently developed techniques in micro framing and streak photography and spectroscopy. At the present time we have built up a fireset and diagnostics and are comparing electrical burst data with that predicted by the FIRESET code. A high resolution 15ns framing camera is currently functional and has been used to examine self illumination effects. Three illumination systems are being prepared to provide single short pulse (2nS) laser illumination, multiple pulse laser illumination and long pulse (μS) flashlamp illumination. These illuminators will allow various forms of direct micro-photography, shadow and Schlieren photography. These techniques will be used to provide direct measurement of shock velocities and histories. We are also investigating the direct measurement of pressure in and behind the shock using the spectral shift in the fluorescence of certain dyes. For this application we are building an intensified imaging spectrograph. We examine the status and plans of the laboratory and present some initial results.

35550 **Optical methods for the study of explosive chemistry.** Trott, W.M.; Renlund, A.M. (Sandia National Labs., Albuquerque, NM 87185). pp 32-37 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WC4.

Although a considerable body of empirical knowledge on shock sensitivity and explosive performance is presently available, practically no information exists regarding the important microscopic physical and chemical processes. Much additional insight into these processes is needed for the development of predictive capabilities in the areas of initiation and performance. In this paper, the authors discuss the application of several optical diagnostic methods for the study of explosive chemistry. They have emphasized techniques which provide good spatial and temporal resolution and are applicable to "single-shot" measurements on pressed, polycrystalline samples of widely used HEs. These techniques include electronic fast-framing photography, time-resolved emission spectroscopy, single-pulse Raman scattering and time-resolved infrared spectral photography (TRISP).

4502 Nuclear

REFER ALSO TO CITATION(S) 34816, 35510, 36227

35551 **(AD-A—178288/7/XAB) Constraints on modeling of underground explosions in granite. Semiannual report No. 1, 10 March-10 September 1986.** Stevens, J.L.; Rimer, N.; Day, S.M. (S-Cubed, San Diego, CA (USA)). Oct 1986. 82p. (SSS-R—87-8312). NTIS, PC A05/MF A01.

This report summarizes our current understanding of the constraints on modeling of underground explosions in granite. Nu-

merical simulations of explosions in granite are compared with near-field waveforms from PILEDRIVER, HARDHAT, and SHOAL, and with peak velocity and peak displacement data from the Hoggar explosions. Numerical simulations agree well with the data at close range. At larger ranges the calculations reproduce the shape of the observed waveforms, but overestimate the observed amplitudes. Dilatancy introduced through the use of an associated flow rule in numerical calculations can make a significant difference in the predicted size of the explosion cavity. The effect is potentially large enough to explain the difference in cavity sizes between the Hoggar explosions and United States granite explosions, however dilatancy also leads to very large near-field ground motion, and eliminates overshoot in the explosion source function.

35552 **(AD-A—178523/7/XAB) Little Boy to Star Wars the evolution of American deterrence. Research report.** Havey, M.E. (Air War Coll., Maxwell AFB, AL (USA)). May 1986. 159p. (AU-AWC—86-093). NTIS, PC A08/MF A01.

The historical and sociological development of the American deterrent posture in the nuclear age is traced since the its dawn at Alamagordo, New Mexico, 16 July 1945, and the use of the Little Boy over Hiroshima three weeks later. A description of Western man's involvement in and reaction to pre-1945 catastrophic circumstances is followed by a comparative examination of the post-1945 changes in national policy in regard to the use and dangers of total war. Using Bernard Brodie as a theoretical deterrent baseline, the author analyzes the ethical and military shifts in U.S. declaratory (versus actual) nuclear policy, through Paul Nitze's statements of future policy in light of strategic defense. The author concludes that extremely effective--not necessarily perfect--defenses can be based dramatically on the beneficial effects of arms control. But at the same time, such a condition must inevitably result in a de facto reversion of U.S. nuclear policy to that of a small, non-counterforce force de frappe deterrent - similar in effect to that of the present French posture. The implications of this upon U.S.-Soviet force balance, the historical trends of the American Way of War, and the present deterrent mindset of the officer corps is left as a grave concern.

4503 Explosion Detection

35553 **(AD-A—178396/8/XAB) Ultrasonic physical modeling of seismic-wave propagation from a graben-like structure: a preliminary report. Scientific report No. 1, 19 February 1985-30 September 1986.** Vassiliou, M.S.; Abdel-Gawad, M.; Tittmann, B.R. (Rockwell International Corp., Thousand Oaks, CA (USA). Science Center). Oct 1986. 33p. (SC—5420.TRF). NTIS, PC A03/MF A01.

Ultrasonic experiments help clarify the problem of seismic-wave propagation in cases where sources are excited in a region with significantly different properties from those of the surrounding propagation medium. Such a case exists, for example, when nuclear explosions are detonated at Yucca Flat. Ultrasonic waves are produced using a breaking pencil lead as a source (step unloading of the surface), and a true displacement conical transducer as a receiver. Measurements are made setting the source off on the half space (made of fine-grained gabbro, with Vp=6.2 km/s), and with a cylindrical graben of 13mm diameter and 2mm depth. The graben was filled with either crystal wax (Vp=2.407) or HPAL3 (an aluminum-filled resin with Vp=3.287). Rayleigh waves for frequency 100 KHz in the model are roughly analogous to 20 s in the Earth. The presence of a source region with significantly slower velocities than the surrounding region appears to lead to a moge complex signal, with more ringing than would be apparent if there were no such source region. The presence of such a source region appears to result in a relative amplification of the high-frequency part of the signal. The frequencies analogous to 3 or 4 s in the Earth appear to be amplified relative to lower frequencies. Although the pencil-lead source used in this study is not exactly similar to an explosion, this result may still be significant. When the source is set off in the garben in an off-center position, a radiation pattern is established, with amplitude varying by a factor of 2 or more. Material effects appear to be accentuated when the source is excited off center.

35554 **(UCID—21049-Rev.1) Seismic noise spectra at Elko, Kanab, Landers, and Mina.** Rodgers, P.W.; Rohrer, R.F. (Lawrence Livermore National Lab., CA (USA)). 26 May 1987. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010848.

The ambient seismic noise at the four Digital Seismic Stations (DSS) operated by the Lawrence Livermore National Laboratory is computed for four 500-second time windows: summer daytime, summer nighttime, winter daytime and winter nighttime. In terms of the averages over these windows, in the seismically important 1-10 Hz band, the order of the DSS stations in quietness is: ELKO<LANDERS<KANAB<MINA. For a one-octave bandwidth, the average peak-peak displacements in nm at 1 Hz are: Elko 0.82 nm, Landers 0.90 nm, Kanab 0.95 nm, Mina 1.8 nm. These spectral noise data show larger than usual slope increases beginning at 1 Hz, particularly, at Mina. These slope changes are not due to DSS system noise which is 14 db below the average station noise. No physical explanation for these slope changes was forthcoming in the data. Comparing these DSS noise spectra in the 1.5 - 10 Hz band with Regional Seismic Test Network (RSTN) data from the stations RSNT and RSNY shows that in terms of averages: RSNT<ELKO<RSNY<MINA. The average peak-peak displacements in nm for a one-octave bandwidth at 1 Hz are: RSNT 0.6 nm, RSNY 2.7 nm.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

5001 Basic Studies

REFER ALSO TO CITATION(S) 35563

35555 **(DOE/ER/60397—H2) A data bank of Antarctic surface temperature and pressure data.** Jones, P.D.; Limbert, D.W.S. (East Anglia Univ. (UK). Climatic Research Unit; British Antarctic Survey, Cambridge). Jun 1987. Contract FG02-86ER60397. 57p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87010689.

A data bank of monthly-mean surface air temperature and sea-level or station-level pressures is presented for 29 stations over the Antarctic region south of 60°S. Considerable attempts have been made to locate missing data in nationally published sources and in World Weather Records. By cross-checking neighboring station data, suspect values have been either verified or corrected. At four sites in the Antarctic Peninsula region, composite records were produced by amalgamating records from a number of short and longer length records at or near the key sites. The four sites were Bellingshausen, Faraday, Esperenza and Rothera. The mean Antarctic temperature series produced by Raper et al. (1984) is updated using the same method of calculation.

35556 **(NP—7770106) Yearly curve and statistics of daily averages and mean daily peaks of air temperatures in West Germany.** Elbing, C. (Technische Univ. Braunschweig (Germany, F.R.). Naturwissenschaftliche Fakultaet). 7 Apr 1986. 277p. (In German). NTIS (US Sales Only), PC A13. File Number DE87770106.

Monthly averages were derived from the air temperature frequency distribution for 11 West German cities after 40 years of observation. The yearly variation of the monthly averages was analyzed to show that M is well described by the zero or first harmonic. The yearly sinus curve was found to depend strongly on the distance from the sea ('dist'). Upon elimination of the influence of site altitudes, a clear interdependence was found between dist and the yearly average. A statistics of daily values was derived from the scatter of the monthly temperature distribution. The yearly curve of the monthly scatter deviates more strongly from the sinus curve. The mean monthly scatter is highest for temperature peaks, but in winter the highest scatter was in minimum values. The minimum scatter was measured in August.

35557 **(PB—87-164992/XAB) NOAA/GMCC (National Oceanic and Atmospheric Administration/Geophysical Monitoring for Climatic Change) calibrations of CO_2-in-air reference gases: 1979-1985. Technical memo.** Thoning, K.W.; Tans, P.; Conway, T.J.; Waterman, L.S. (National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.). Jan 1987. 68p. (NOAA-TM-ERL-ARL—150). NTIS, PC A04/MF A01.

The results of 423 CO_2-in-air reference gas calibrations from 1979 to 1985 are presented. Time dependent concentrations for the NOAA secondary and tertiary standards are plotted and tabulated. A preliminary analysis of the uncertainty of the assigned CO_2 concentrations for the reference gases used in the field for atmospheric measurements gives a value of 0.07 ppm relative to the WMO scale maintained by SIO. A comparison of 23 tanks with both SIO and NOAA calibrations shows no significant difference between them, the mean difference being 0.03 + or - 0.03 ppm. Calibrations by NOAA of 3 NBS SRM CO_2-in-air tanks show an average offset of 0.25 ppm from the NBS certified values.

35558 **(PB—87-165213/XAB) Minnesota 1973 atmospheric boundary-layer experiment: micrometeorological and tracer data archive. Set 1 (Revision 2) documentation report. Final report.** Woodruff, R.K.; Droppo, J.G.; Glantz, C.S. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1987. 23p. NTIS, PC A02/MF A01.

Supersedes PB—85-243152.

An archive for micrometeorological and tracer-dispersion data were developed by Battelle, Pacific Northwest Laboratories for the U.S. Environmental Protection Agency. The archive is designed to make the results of extensive field tests readily accessible to EPA for model testing, development, and verification efforts. The report provides documentation for one of the archived data sets, The Minnesota 1973 Boundary Layer Experiment. The aim of the effort is to archive invaluable data sets in a timely fashion before the necessary supporting information about the data becomes lost forever. The entries in the documentation report are as follows: data set fact summary, a narrative description of experiment and data, special information, references, a description of archive data files, contacts (names, addresses, and phone numbers) and standard experiment summary table. Revision 2 includes previously unpublished rawinsonde profile data.

35559 **(PB—87-167755/XAB) Stable-plume dispersion over an isolated hill: releases above the dividing-streamline height.** Snyder, W.H., Lawson, R.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Mar 1987. 14p. (EPA—600/D-87/057). NTIS, PC A02/MF A01.

Experiments were conducted in a stably stratified towing tank wherein the density gradient was linear and the dividing-streamline height H(D) was half the hill height. Effluent was released at three elevations above H(D). Pairs of tows were made such that, in one tow, the hill (upside-down) was fully-immersed in the water and the towing speed was adjusted to provide a natural H(D) surface. In the second tow of the pair, the hill was raised out of the water to the point where only the top half of the hill was immersed, thus, forcing a flat H(D) surface as is used in some mathematical models. The results suggest that the assumption is a reasonable approximation to make, at least with regard to predicting the locations and values of maximum concentrations and areas of coverage on the windward side of the hill.

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REFER ALSO TO CITATION(S) 34467, 34485, 34486, 34487, 34488, 34489, 34490, 34491, 34498, 34504, 34553, 34611, 34620, 34623, 34626, 34637, 34812, 34814, 34815, 35026, 35043, 35068, 35072, 35080, 35094, 35106, 35107, 35108, 35109, 35110, 35288, 35294, 35371, 35433, 35559, 35699, 35702, 35709, 35723, 35730, 35731, 35799, 35800, 35858, 35861, 35872

35560 **(AD-A—178590/6/XAB) New methods for obtaining scattering and absorption from tropospheric visible-spectrum data. Final report, 1 July 1984-31 December 1986.** Gordon, J.I. (Viz Ability, Corvallis, OR (USA)). 28 Feb 1987. 155p. (VA—187-1). NTIS, PC A08/MF A01.

During the contract period, new methods for obtaining absorption, aerosol and total-scattering optical thickness, and single-scattering albedo from tropospheric visible spectrum data were published and then used on two extant sets of tropospheric optical data in the visible spectrum. One ground-based set of measurements predated heavy atmospheric pollution. The other set of airborne measurements was from a metropolitan area containing pollution sources. Application of the methods to these data sets further developed the methods, provided substantial examples of their use, served to update the data, and provided a means to access all the atmospheric optical data measured prior to 1976. A significant finding was that the aerosol-scattering optical thickness of the total atmosphere or of separate haze layers can be described by a modified Angstrom equation in which the constant is a function of the power of the wavelength.

35561 **(AD-A—178973/4/XAB) Laser remote sensing of the atmosphere.** Killinger, D.K.; Menyuk, N. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 2 Jan 1987. 11p. (JA—5872). NTIS, PC A02/MF A01.

Pub. in Science, Vol. 235, 37-47(2 Jan 1987).

Laser beams can be used as long-range spectroscopic probes of the chemical composition and physical state of the atmosphere. The spectroscopic, optical, and laser requirements for atmospheric laser remote sensing are reviewed, and the sensitivity and limitations of the technique are described. A sampling of recent measurements includes the detection of urban air pollution and toxic chemicals in the atmosphere, the measurement of global circulation of volcanic ash in the upper atmosphere, and the observation of wind shear near airports.

35562 **(ANL/EES-TM—321) Transportation energy and emissions modeling system (TEEMS): Configuration for forecasting transportation-source emissions for the 1985 test runs.** Vyas, A.D.; Saricks, C.L. (Argonne National Lab., IL (USA)). Oct 1986. Contract W-31109-ENG-38. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009994.

As part of the model development and testing efforts of the National Acid Precipitation Assessment Program, the Transportation and Emissions Modeling System (TEEMS) was evaluated and tested for its ability to forecast emissions of acid-rain precursor pollutants. This report describes the testing of various TEEMS components. A discussion of the driver inputs for the activity projection modules is followed by a description of the regionalization and emissions-computation procedures. A base-case economic and demographic test scenario and two alternative scenarios are described. Results of activity- and emissions-forecasting model runs are presented, and the sensitivity of TEEMS components to demographic, economic, and technological changes is discussed.

35563 **(ANL/ER-TM—87-1) 3CPO: Cloud Chemistry and Cloud Physics Organization: Coordination document.** Sisterson, D.L. (ed.). (Argonne National Lab., IL (USA)). Jun 1987. Contract W-31109-ENG-38. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010796.

This Coordination Document describes plans of an ad hoc committee of atmospheric chemists, physicists and meteorologists for a joint convective storm measurement program to be conducted in east-central Illinois during the summer of 1988. This field program will be a one-time effort, and cooperative participation is encouraged by all interested members of the extended scientific community. Its principal objective to provide as complete a description as is technically possible of the dynamical, microphysical, and chemical processes occurring within convective storms. Separate abstracts have been prepared for the individual plans. (ACR)

35564 **(BNL—39400) Design of a cryogenic sampler for gaseous hydrogen peroxide in ambient air.** Chetty, T.; Karohl, D. (Massachusetts Inst. of Tech., Brookhaven, NY (USA). School of Chemical Engineering Practice-Brookhaven Station; Brookhaven National Lab., Upton, NY (USA)). Jun 1986. Contract AC02-76CH00016. 73p. (MIT/BNL—86-9). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010388.

This project designed and characterized the performance of a cryogenic sampler for gaseous H_2O_2. In preliminary experiments, 1-cm ID, 30 cm long U-tube in an acetone-dry ice bath achieved complete peroxide collection efficiency (E/sub H2O2/) from prepared air at 50% relative humidity (RH) and 1.5 ppbv H_2O_2. The performance of the U-tube sampler was further evaluated on the basis of water collection efficiency, a criterion which indicates the time required to collect a sample sufficiently large to analyze for H_2O_2. Water collection efficiency (E/sub H2O/) averaged 6.2 +- 2.9%, indicating good reproducibility but a far lower E than observed for H_2O_2, suggesting that the mechanisms for water and peroxide removal in the cryogenic U-tube differ significantly. Water loss as ice crystals in the exit air stream was observed throughout the runs. Additionally, the value of E/sub H2O/ increased with increasing humidity, and decreased with increased run time. A model of heat and mass transfer in the U-tube, based on Kays' transport correlations for developing laminar flow, yielded a reasonable agreement with experimental work. The model also predicts the observed phase change behavior of water in the U-tube, and supports the observed water loss mechanism.

35565 (BNL—39542, pp 34) **Nonlinearity/PRECP-PRocessing of Emissions by Clouds and Precipitation.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This project is a multilaboratory effort aimed at the key atmospheric question in the acid deposition problem to determine the spatial scale over which amounts of airborne acidic or acidifying pollutants deposited to the surface are linearly related to the emissions of sulfur and nitrogen oxides. The specific objective of this program is to obtain a scientific basis so that one can determine how the wet deposition of pollutants depends upon pollutant input; to do this one must study the PRocessing of Emissions by Clouds and Precipitation (PRECP). The research will consist of three highly interactive components: diagnostic modeling, field measurements, and laboratory experiments.

35566 (BNL—39542, pp 35) **Atmospheric tracer and instrumentation developments.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This project is comprised of two principal efforts: (1) the development and utilization of atmospheric tracer compounds for dispersion and long-range transport studies, and (2) the development and validation of unique instrumentation for applications in atmospheric tracer studies and other energy-related areas where gaseous tracers can be used such as in air infiltration and leak detection. For the sub-task of atmospheric tracer developments, efforts are directed at the testing and validation of state-of-the-art samplers and analytical procedures for the family of perfluorocarbon tracers (PFTs), the search for new PFTs with lower ambient background levels, the preparation of the respective gas standards, participation in interlaboratory comparison and validation test programs, assistance to other laboratories in DOE-supported field tracer studies, and, finally, implementation of an effort within the programs at BNL that are directed at tracer validation of short- and long-range dispersion and transport models as applied to energy-related pollution problems.

35567 (BNL—39542, pp 36) **Aerosol chemistry and dynamics.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Airborne particles readily serve as reaction and transport media for many harmful gaseous pollutants by providing sites for condensation, sorption, or catalytic reactions. The presence of aerosols in the atmosphere is also responsible for the occurrence of many important climatic processes such as fog and cloud formation and visibility degradation. Experiments are under way to measure the rate and extent of droplet growth in a humid environment, to study the chemical equilibrium between saline droplets and trace gases, and to investigate the chemical state of adsorbed gases on particle surfaces. New techniques including single droplet evaporation and Mie-resonance enhanced Ramon Spectroscopy are being developed. Extensive thermodynamic data are being obtained for concentrated inorganic salt solutions, which constitute a large portion of ambient aerosols. Pertinent theories on aerosols phase transformation and gas-droplet interactions are being developed. It is expected that the results from this research program will lead to a better understanding of the basic mechanisms by which pollutants may transform, transport, and accumulate in the environment.

35568 (BNL—39542, pp 37) **Atmospheric aerosol microphysics.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Aerosols are a major factor in the formation, transformation, and removal processes of both natural and anthropogenic gaseous and particulate atmospheric emissions including those from energy production. In order that the undesirable effects of these emissions may be anticipated, measured, and controlled, detailed treatments of the elementary composition-related transformations and interactions involving aerosols must be available. The efforts under this program are directed toward evolving these treatments. Lifshitz-van der Waals theory is being developed for aerosol application including computations of molecular cluster and aerosol particle collision rates and computations of dispersion free energies. Special attention is given to free-molecular and transition regime particles and their microphysical properties. Computational methods for the description of heterogeneous atmospheric chemistry, which ultimately will be useful for predictive purposes, are to be collaboratively developed and applied in the study of systems containing gaseous and particulate pollutants.

35569 (BNL—39542, pp 38) **Atmospheric chemistry and physics of organic pollutants.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This program is directed at gaining a better understanding of the chemical and physical mechanisms affecting organic pollutant levels and their interactions in the troposphere. Organic effluents from new and changing energy technologies are of interest because of their potential impact on the environment and public health, both as potential toxins and toxin precursors and as reactive species leading to increased levels of photochemical oxidant and aerosol pollutants. This program is a combined interactive effort involving laboratory, computer-modeling and focused field studies to systematically examine the mechanisms for the atmospheric formation and removal of organic compounds, as well as establishing their interactions in gaseous and cloud water chemistry. Laboratory studies of the kinetics and mechanisms of thermal and photooxidation reactions of peroxyacetyl nitrates (PANs), peroxyalkyl nitrates, organic nitrates and peroxides as well as hydrocarbon NO_3 reactions using long-path Fourier transform infra-red (LPFTIR) gas chromatography mass spectrometry (GCMS), laser-Raman and laser photothermal spectroscopic techniques are under way.

35570 (BNL—39542, pp 39) **Laser spectroscopy of gases and aerosols.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Goals of this research are the development of laser-oriented instrumentation for laboratory research of the photophysical properties of aerosols and the execution of such laboratory studies. Methodologies under development will allow in situ analysis and determination of size, mass and chemical composition of both aerosol particles and the surrounding gas as a function of their thermodynamical parameters. Detection techniques being investigated for this task are: laser intra-cavity photothermal spectroscopy (LIPS); photothermal modulation of mie scattering; and laser vibrational circular dichroism spectroscopy.

35571 (BNL—39542, pp 40) **Advancements in atmospheric tracers and related instrumentation.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

With the increasing use of perfluorocarbon tracers (PFTs) in long range atmospheric transport and dispersion experiments, a corresponding continued need for on-going improvements in the laboratory gas chromatographic analysis system is manifested. Every newly proposed atmospheric tracer experiment increasingly requires the laboratory analysis system to routinely perform at the limits of its PFT sensitivity. The increasing number of PFTs and

their increasing diverse atmospheric application subjects the laboratory analysis system to a multitude of background interferents which must be systematically and efficiently removed for continued, reliable operation of the laboratory analysis system. As long range atmospheric transport and dispersion experiments become more sophisticated with results which are to be used for comparison and validation of atmospheric transport and dispersion models, an increased importance must be given to maintaining the quality of the analytical results of the laboratory analysis system. This program, initially emphasizing the laboratory gas chromatograph analysis system, will be directed at improving the resolution, speed and automation of the analyses through the microparticulate packed columns, capillary columns, pressure balance switching techniques, on-column cold trapping, and improving the precision of the laboratory analysis and calibration system.

35572 (BNL—39542, pp 43) **Building infiltration and ventilation.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The Brookhaven Air Infiltration Measurement System (BNL/AIMS) will be further developed and implemented for the release of nanogram quantities of inert conservative tracers into the heated and air conditioned living spaces of buildings, and other structures for the purpose of determining the extent to which air infiltration is a burden to the heating and/or cooling of that space. By sampling for the steady state concentration of PFT attained within the building, the infiltration rate can be determined. The capillary adsorption tube sampler (CATS) for obtaining 2 week to 2 month averaged steady state PFT concentrations and BATS for obtaining short duration integrated PFT levels provide demonstrated capabilities for measuring these tracers in buildings. The goals of this program are to fully characterize the capability of the PFT technique including the design and performance characteristics of the sources and the samplers. Field studies in homes will be performed to evaluate the concept of multiple tracers for determining air exchange rates between floors as well as infiltration rates. The multizone modeling capability with BNL/AIMS will be used to determine source strengths and/or sinks of indoor air pollutants.

35573 (BNL—39542, pp 46) **Preparation and participation in ANATEX.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Aimed at the testing and verification of long-range atmospheric transport and dispersion models, the Across North America Tracer EXperiment (ANATEX) will be the longest range tracker experiment attempted to date with the perfluorocarbon tracer (PFT) technology. With samplers deployed at about 75 sites, 61 in the US and 14 in Canada, up to 3000 km from the release point, a total of about 7600 24-h ground samples will be collected during the 3-month period from January through March 1987. In addition, some 3700 tower and 2400 aircraft samples will be collected, plus 150 ground samples in Europe and around the world for a total of almost 14,000 analyses of 6 PFTs each. PFT material will be released for 3-h periods every 2.5 days at 100 kg per release, requiring a total of about 3600 kg of two PFTs (1800 kg each), each having a background concentration of less than 0.3 fL/L (0.3×10^{-15} L/L). Brookhaven is responsible for finding such ultra-low background PFTs, testing for compatibility with the sampling equipment, performing gas chromatograph column technology research to provide the analysis capability for the present and new PFTs, studying the performance of the samples' adsorbent materials, providing the capability for real-time as well as collected aircraft sampling, and analyzing more than 4000 samples.

35574 (BNL—39542, pp 47) **Development and use of sampling and analysis techniques in support of NOAA-related atmospheric tracer experiments.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The studies conducted in this program are in direct support of the NOAA atmospheric tracer program and are complementary with the atmospheric tracer and instrumentation development ongoing at BNL. Having an ultimate goal of demonstrating the capability of PFTs for detection of tagged air masses at great distance (i.e., greater than 500 km), the NOAA program has supported BNL participation in the areas of (1) instrumentation developments, (2) evaluation of existing instrumentation, (3) modification and improvements in sampling and analysis instrumentations, and (4) large-scale meteorological tracer studies at distances up to 1200 km. A number of the instrumentation developments for the detections of PFTs have direct application to the NOAA program goals. Part of the direction of this program is to evaluate and intercompare existing sampling and analysis methodologies and techniques by performing laboratory and small-scale field experiments with instrumentation developed at BNL and elsewhere. And, finally, in conducting long-range transport studies, NOAA will use the expertise at BNL to automate the analytical techniques for the determination of PFT samples collected during their field experiments, to assist in the analysis of those samples, and to otherwise assure the reliability of PFT sampling and analysis results.

35575 (BNL—39542, pp 50) **SRM exhaust particle optical property measurements.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

A fundamental understanding of the emission, absorption, and scattering of light by small particles is of great importance in many areas of science and technology. In the exhaust plumes of solid rocket motors (SRM), a significant portion of the mass appears as micrometer-sized particles composed specifically of Al_2O_3, ZrO_2, C and/or MgO. A detailed knowledge of the optical properties of these particles is necessary to evaluate propellent formulation changes and to assess the environmental effects of exhaust effluents. The overall objective of the program is, therefore, to experimentally determine the optical constants of SRM exhaust particles over the spectral range $0.3 + 0.10$ μm and the temperature range 300 to 2500 K using laser light scattering and extinction measurement techniques. A high temperature light-extinction apparatus is under construction which, upon completion, will allow routine optical property measurements to be carried out with SRM exhaust particle samples supplied by the contractor. Efficient data retrieval algorithms are being developed for deducing the desired optical constants from the multi-wavelength extinction measurements.

35576 (BNL—39542, pp 52) **Measurements of gaseous hydrogen peroxide by impinger and diffusion scrubber sampling in ozone-free ambient air.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

This program was developed to allow participation of BNL in the intercomparison of gaseous H_2O_2 measurement techniques conducted near Los Angeles, CA in August, 1986, as part of a larger Carbonaceous Species Intercomparison coordinated by the California Air Resources Board. The BNL gaseous H_2O_2 techniques employing impinger or diffusion scrubber sampling of ozone-free ambient air were operated alongside several other techniques in this intercomparison.

35577 (BNL—39542, pp 53) **Cloud water acidity measurements and formation mechanisms.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The overall objective of this project has been development of enhanced understanding of the role of liquid-water clouds in formation of acid precipitation. Processes being examined include: (1) incorporation by clouds of soluble strong acid present in pre-cloud air, and (2) in-cloud gas-aqueous reaction, i.e., dissolution of reactive gases followed by aqueous-phase reaction. Substances of concern include gaseous SO_2, NO, NO_2, HNO_3, NH_3 and O_3; aerosol H^+, NH_4^+, SO4/sup =/, NO_3^-; aqueous H^+, NH_4^+, SO4/sup =/, NO_3^-, H_2O_2. Determination of species concentrations in the several phases in conjunction with laboratory-determined equilibrium and kinetic data permits examination of chemical equilibria and evaluation of reaction rates, thereby enabling the important in-cloud reactions to be identified. Principal components of this project in addition to field measurements and interpretation have been development and evaluation of instrumentation in support of the aircraft measurements and directed laboratory study of processes identified as potentially important to description of gas-aqueous reactions in clouds.

35578 (BNL—39542, pp 55) **Long-term trace gas and aerosol measurements at Whiteface Mountain, New York.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

There is much concern currently that ecologically sensitive areas of the northeast US and eastern Canada are being injured by acidic substances deposited in precipitation. The deposition of acidic pollutants in the absence of precipitation (so-called dry deposition) is not as well publicized, but may be just as important a source of acidity to these areas. This program is an attempt to provide the needed atmospheric chemical data in one of the sensitive receptor areas, the Adirondack Mountain region of northern New York. In this program year-round measurements of oxides of nitrogen, sulfur dioxide, nitric acid, and aerosol composition are made from the summit of Whiteface Mountain, employing a research station maintained by the Atmospheric Sciences Research Center, SUNY-Albany. Highly sensitive modified commercial instruments are used for real-time detection of sulfur and nitrogen oxides and nitric acid, and a three-stage filter pack is used for integrated measurement of aerosols, nitric acid, and sulfur dioxide. These measurements indicate the identities of the major acid-producing pollutants in the Adirondacks, and, when coupled with chemical analyses of cloud water and precipitation samples, provide evidence of in-cloud acid formation processes. During periods of clean air, the data are representative of background air composition in the northeast US.

35579 (BNL—39542, pp 56) **Support of SCCCAMP mesoscale tracer studies.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The South Central Coast Cooperative Aerometric Monitoring Program (SCCCAMP) is managed by eight public and private agencies: California Air Resources Board; California Coastal Commission; Department of Interior, Minerals Management Service; San Luis Obispo County Air Pollution Control District (APCD); Santa Barbara County APCD: Ventura County APCD: US Environmental Protection Agency, Region IX; and the Western Oil and Gas Association. The overall objective of the SCCCAMP field measurements program is to develop a comprehensive aerometric data base with which to evaluate and apply numerical photochemical simulation models to assess the aggregate impact of offshore petroleum industry sources on ozone and NO_2 concentrations in the Ventura/Santa Barbara County area. Tracer studies are one of the many components of the SCCCAMP field measurements program that are intended to address the basic objective. Brookhaven is subcontracting to SRI International to assist with the preparation for field deployment of the perfluorocarbon tracer (PFT) samplers developed at Brookhaven - the Brookhaven Atmospheric Tracer Samplers (BATS). The tasks include bakeout and calibration of the BATS, supplying passive samplers, assisting Battelle Northwest with the transfer of preparation procedures, and quality assurance of PFT analyses.

35580 (BNL—39542, pp 57) **Miscellaneous air infiltration programs.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Concern for the degradation of indoor air quality due to weatherization of homes and buildings and the energy performance of such facilities has resulted in a need for advanced measurement technology to determine the multizone flow characteristics of buildings. The Brookhaven Air Infiltration Measurement System (BNL/AIMS) is the only technique currently available to cost effectively provide a measure of internal and external air flow patterns into, out of, and within buildings. As such, they are supplying this system capability to universities, architectural firms, air handling system designers, etc., to establish the protocols for the implementation of the measurement technique in various scenarios. In addition, they will assist in the transfer of this technology to the private sector.

35581 (BNL—39542, pp 58) **Residential indoor air quality study in southern California.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The Southern California Gas Company (SoCal) is concerned about the consequences of unvented gas appliances on the degradation of the indoor air quality (IAQ) in homes serviced by them. Attempts to conserve energy by tightening the homes or the effects of introducing new types of appliances and heating sources can also have a consequence on IAQ. Brookhaven is supporting SoCal in their study of about 600 homes by providing their air infiltration measurement system (BNL/AIMS) over three separate seasons to learn more about the ventilation characteristics of homes in that area. Brookhaven is responsible for computing the results of measurements implemented in the homes by teams from SoCal and Tetra Tech, Inc., a contractor to SoCal. This will provide a unique database of infiltration rates in that area of the country as well as an indication of the general reliability of the passive measurement technique. The data obtained will be statistically studied to determine the applicability of two-zone modeling of ranch and two-story houses for the determination of indoor NO_2 source strengths (from combustion devices) and NO_2 removal rates by indoor surfaces. A Phase II study of 300 homes is now being planned.

35582 (BNL—39588) **Long-range (CAPTEX [Cross-APpalachian Tracer EXperiment]) and complex terrain (ASCOT [Atmospheric Studies of COmplex Terrain]) perfluorocarbon tracer studies.** Jeffter, J.L.; Yamada, T.; Dietz, R.N. (Brookhaven National Lab., Upton, NY (USA); National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab.; Los Alamos National Lab., NM (USA)). 1986. Contract AC02-76CH00016. 31p. (CONF-8609215—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010059.

From Ispra courses: regional and long-range transport of air pollution; Ispra, Varese, Italy (15 Sep 1986).

Perfluorocarbon tracer (PFT) technology, consisting of tracers, samplers, and analytical equipment, has been deployed in numerous meteorological experiments for the verification of long-range and complex terrain transport and dispersion models. The CAPTEX (Cross-APpalachain Tracer EXperiment) "83 was conducted from mid-September through October 1983, in which seven 3-h tracer releases (5 from Dayton, Ohio, and 2 from Sudbury, Ontario) were made of a single PFT. Ground sampling occurred at 80 sites in the northeastern US and southeastern Canada at distances of 300 to 1100 km from the release sites, with a total of 3000 samples collected. Seven aircraft gathered 1600 crosswind and vertical spiral samples at distance of 200 to 900 km from the release sites. Peak ground concentrations of over 30 times background and peak aircraft values of over 150 times background were measured at the most distant sites; some typical results are shown. The branching atmospheric trajectory (BAT) long-range transport was described. The model-calculated maximum ground level PFT concentrations were compared with the measured concentration isopleths as well as through the use of scatter diagrams of concentrations, spatial errors, and frequency of space- and time-averaged concentrations. The average spatial error found for each of the 7 releases ranged from 1.3° to 1.7° lat. The crosswind standard deviations of aircraft traverses at 600 to 800 km downwind varied from 12 to 20 km which corresponded to 1.0° to 1.6° lat., indicating that the model was accurate to within one standard deviation of the real-time tracer profiles. On average, for the 7 runs, 50% of the model-calculated concentrations were within a factor of 20 of the observations, indicating that, in general, 1° lat. shifts can easily cause order-of-magnitude changes in observed concentrations.

35583 (CONF-860123—1) **Forest responses to deposition of air-borne chemicals.** Winner, W.E.; Leininger, T.D.; McLaughlin, S.B. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Lab. of Air Pollution Impact to Agriculture and Forestry; Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009824.

From 65. annual meeting of the Appalachian Society of American Foresters: atmospheric deposition and forest productivity; Raleigh, NC, USA (30 Jan 1986).

The impact of air pollutants on forest growth and productivity are discussed along three lines of research: (1) response of trees to gaseous pollutants; (2) evidence of growth declines from dendroecological studies; and (3) the response of forest canopies to the deposition of chemicals from the atmosphere.

35584 (CONF-870245—, pp 31-35) **Role of the universities in waste management and education.** Colglazier, E.W. (Univ. of Tennessee, Knoxville). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The twofold purpose of this presentation is to communicate to universites that the Oak Ridge Model contains significant opportunities for them and to communicate to industry and government that universities can make sizeable contributions in helping to solve hazardous waste management problems. An overview is presented of transformations that have occurred at universities over the last several years.

35585 (CONF-870245—, pp 122-126) **DOE interaction with the EPA SITE Program (HAZWRAP).** Petty, J.L. Jr. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The Department of Energy (DOE) is actively participating in a cooperative effort with the Environmental Protection Agency (EPA) and the Department of Defense (DOD) in the areas of hazardous waste cleanup demonstrations and innovative technology research and development. This three-agency cooperative effort grew from a joint DOD/EPA working group formed in the Spring of 1985. Because of the success of that effort and to continue the cooperation among federal agencies on hazardous waste clean-up, EPA sponsored another working group meeting on June 11-12, 1986. DOE was invited to attend, and representatives from all three agencies discussed the progress of the previous year's proposed joint efforts between the DOD and EPA, recommended new joint efforts, and discussed EPA's Superfund Innovative Technology Evaluation (SITE) Program.

35586 (CONF-870245—, pp 367-377) **Risk assessment of hazardous waste facilities.** Holton, G.A.; Arendt, J.S.; Rooney, J.J. (JBF Associates, Inc., Knoxville, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Public health and safety, environmental, and economic risks from operating hazardous waste facilities result from potential gaseous and particulate emissions, liquid effluents, leachates, and material handling accidents. Quantitative risk assessment is the discipline employed to arrive at a value or, more realistically, a range of values, that describe the potential frequency and consequence of these release events. This paper presents a systematic, phase approach for performing a risk assessment of potential accidents associated with a hazardous waste facility design. It also demonstrates how the results of a risk analysis can present an accurate risk-picture of the facility for use in meeting regulatory and siting requirements and making decisions. A typical analysis is outlined and methods that can be used to convey to the public the results of this type of risk analysis are explored.

35587 (DOE/PC/91101—T3) **Sulfur dioxide removal from flue gases by supported copper and iron absorbents: Technical report No. 3, 2/16/87-5/15/87.** Melson, G.A. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry). Jun 1987. Contract FG22-86PC91101. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010772.

During the past three months, work has continued on the characterization and evaluation of Cu/Al_2O_3 sorbent materials. Most of the effort has focused on sorbents prepared from 1/16" Al_2O_3 spheres provided by UOP Inc. The copper was impregnated either by using copper(II) acetate and an extraction technique (1) or copper(II) nitrate in aqueous solution.

35588 (DOE/PETC/TR—87/9) **Fine-particulate emissions from stationary sources and control technologies.** Pan, Y.S. (USDOE Pittsburgh Energy Technology Center, PA). Jun 1987. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87010710.

In this report, the sources of fine-particulate emissions and the effects on the emission rates from coal-fired stationary sources are reviewed. The current regulatory standards for particulate matter and the possible future standards are discussed. Conventional control devices, such as electrostatic precipitators, fabric filter baghouses, and scrubbers, and their effectiveness in removing fine particulates are examined. Current research activities in electrostatic precipitator performance improvement, fabric filter baghouse development, and unconventional fine-particulate-removal approaches are summarized. Finally, the potential research areas for fine-particulate control are outlined and reviewed.

35589 (PB—87-68696/XAB) **Compendium of methods for the determination of toxic organic compounds in ambient air. Supplement. Rept. for April 1984-September 1986.** Riggin, R.M.; Winberry, W.T.; Tilley, N.V. (Battelle Columbus Labs., OH (USA)). Sep 1986. 118p. NTIS, PC A06/MF A01.

Supplement to report dated Apr 84, PB—87-168688.

Determination of toxic organic compounds in ambient air is a complex task, primarily because of the wide variety of compounds of interest and the lack of standardized sampling and analysis procedures. This methods compendium was prepared to provide a standardized format for such analytical procedures. A core set of five methods covering 29 air toxic compounds was presented in the original document. In an effort to update the original compendium, four new specific methods were added. With this addition, the compendium now contains nine standardized sampling and analysis procedures covering 36 air toxic compounds. As advancements are made, the current methods may be modified from time to time along with new additions to the compendium.

35590 (PB—87-160685/XAB) **Calibration of diatom-pH-alkalinity methodology for the interpretation of the sedimentary record in Emerald Lake Integrated watershed study. Final report, 6 May 1985-10 October 1986.** Holmes, R.W. (California Univ., Santa Barbara (USA). Marine Science Inst.). 10 Oct 1986. 83p. NTIS, PC A05/MF A01.

The present study was designed to establish quantitative relationships between lake air-equilibrated pH, alkalinity, and diatoms occurring in the surface sediments in high-elevation Sierra Nevada Lakes. These relationships provided the necessary information to develop predictive equations relating lake pH to the composition of surface-sediment diatom assemblages in 27 study lakes. Using the Hustedt diatom pH classification system, Index B of Renberg and Hellberg, and multiple linear regression analysis, two equations were developed which predict lake pH from the relative abundance of sediment diatoms occurring in each of four diatom pH groupings.

35591 (PB—87-161253/XAB) **Health-hazard evaluation report HETA 85-131-1731, Hexcel Corporation, Dublin, California.** Belanger, P.L.; Thoburn, T.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 29p. (HETA—85-131-1731). NTIS, PC A03/MF A01.

Possible exposure of workers to pyrolysis products of organic amines, isocyanates, epoxies, and organic solvents was investigated as a result of a request. Hexcel manufactures industrial chemicals, pharmaceutical intermediates, and urethanes. In the industrial line, work involves the making of structural materials of honeycomb and fiber composites including epoxy resin composites. No overexposures to inorganic mercury or acetone were detected during the study. Fume hoods in the research and development area were tested; all capture velocities were within guidelines. In June of 1984 there was an accidental loss of control of a reaction (called an exotherm), producing heat, fumes, and odors. This exotherm caused elevated liver enzyme levels in exposed persons. While these levels remained high for several months, there was no sign of illness associated with them. The potential for liver toxicity requires that such exposures be kept to a minimum. The authors recommend that adequate volumes of make-up air be available to each lab to compensate for air being exhausted by the hoods. The lab ventilation systems must be balanced relative to the hallways. A proper respirator program should be instituted. No portable fans should be used in the labs. Personal protection and ventilation procedures should be established to reduce exposures to exotherm products.

35592 (PB—87-161287/XAB) Health-hazard evaluation report HETA 85-256-1716, AMF Head Division, Boulder, Colorado. Pryor, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1986. 18p. (HETA—85-256-1716). NTIS, PC A02/MF A01.

A request was made by a representative of AMF Head Division of Boulder, Colorado, for an evaluation to be made of possible employee exposure to methylene-bisphenyl-isocyanate (BDI), methylene-chloride, 1,1,1-trichloroethane, naphtha, sodium-hydroxide, methyl-ethyl-ketone (MEK), and methyl-isobutyl-ketone (MIBK). The author concluded that noise exposure was excessive for employees working in racket stripping, refill, and fill/sand refinishing areas. No dangerous exposure levels were found for the chemicals under study with the exception of methylene chloride, which may be a health hazard for employees directly involved with its use due to its carcinogenicity. It is recommended that employees exposed to 1,1,1-trichloroethane and sodium hydroxide wear proper clothing to prevent direct contact or splashing onto the skin.

35593 (PB—87-161295/XAB) Health-hazard evaluation report HETA 85-254-1722, United Technologies Diesel Systems, Springfield, Massachusetts. Kerndt, P.R.; Rondinelli, R.; Burr, G. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1986. 29p. (HETA—85-254-1722). NTIS, PC A03/MF A01.

Due to a request from Local 206 of the International Union of Electrical, Radio and Machine Workers, an evaluation was made of effects of metal dusts that occur as a result of sharpening and repairing tools at United Technologies Diesel Systems, Springfield, Massachusetts. Concentrations of cobalt in personal air samples ranged from not detectable to 0.24mg/cu m. Respirable dust levels ranged from 0.04 to 0.72 mg/cu m. A range of 0.24 to 5.3mg/cu m was noted for total nuisance dust. Tungsten was not detected in personal air samples. Nickel was detected up to 5.0 micrograms/cubic meter. The authors conclude that a potential health hazard exists from airborne exposure to cobalt. Recommendations by the authors include: modifications to the local exhaust ventilation system; employee training; improvement in general housekeeping; advising employees of health effects of exposure to metal dusts; yearly pulmonary function testing; baseline chest x-rays; maintaining medical records for at least 30 years; discouraging smoking on the job.

35594 (PB—87-162863/XAB) Industry-wide studies report of an industrial-hygiene survey at the Childrens' Hospital Medical Center, Cincinnati, Ohio. Ringenburg, V.L.; Morelli-Schroth, P.; Elliott, L.J.; Mortimer, V.; Kercher, S. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Jul 1986. 50p. (IWS—152.19). NTIS, PC A03/MF A01.

An industrial hygiene survey was conducted at Children's Hospital Medical Center Facility in Cincinnati, Ohio, as part of an industry-wide study to evaluate occupational exposure to ethylene oxide (EtO) in hospital workers and to evaluate engineering controls. Eight-hour time-weighted average (TWA) EtO exposure test results indicated that two surgery and one respiratory-therapy personal samples were below the revised OSHA permissible exposure limit, but above the NIOSH level of less than 0.1 parts per million (ppm). Findings from nondetectable to 2.61 ppm were found in 16 surgery-area EtO TWA samples. The authors recommend the following measures to reduce EtO exposure potential at this facility: use of appropriate gloves while changing EtO cylinders and while unloading EtO sterilizers; installation of a double-valve connection system to minimize leakage during cylinder change; installation of a local-exhaust ventilation hood over the sterilizer safety relief valve and coupling point; waiting 15 minutes to unload the EtO sterilizer; restricting access to sterilizer areas; periodic retraining of workers in proper procedures.

35595 (PB—87-162871/XAB) Health-hazard evaluation report HETA 84-262-1734, Friction Division Products, Trenton, New Jersey. Seixas, N.; Ordin, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 53p. (HETA—84-262-1734). NTIS, PC A04/MF A01.

A request was made by the International Chemical Workers Union on behalf of employees at Friction Division Products to examine possible exposure to asbestos. Approximately 120 employees were engaged in the manufacture of auto and truck brake shoes at the facility. Asbestos was used as a raw material for about 90% of the shoes made. At the time of the inspection, working conditions were poor with asbestos exposure excessive in all areas, including drum mix, preform, grinding, tables and presses. The ventilation system was not properly maintained and measures used to keep the asbestos from becoming airborne were not adequate. Production was allowed to continue even when the debagger was not working. Of 20 workers x-rayed, 2 showed asbestosis. Asbestos fibers were present on work clothes, thus indicating the possibility for contamination to occur at the homes of the workers. The authors conclude that a substantial health hazard exists for workers at this facility and that there is a potential hazard for families of workers.

35596 (PB—87-162905/XAB) In-depth industrial-hygiene survey report of the Bunge Corporation, Kansas City, Kansas. Blade, L.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Sep 1986. 58p. (IWS—149.10). NTIS, PC A04/MF A01.

Potential exposure of workers to phosphide was examined during an in-depth industrial hygiene survey at the Bunge Corporation, in Kansas City, Kansas, where the gas was used as a grain fumigant. During the study, 14 men were employed at the facility. Tablets of aluminum phosphide were added to the grain mass for fumigation. General dilution ventilation resulted from outside air entering the work areas through ventilation louvers; there was also a local-exhaust ventilation system. Air samples revealed that, when the fumigant dispensers were being filled, workers in the area had significant exposure. At the time of the survey the relative humidity in the facility was high, permitting the reaction to phosphide to occur more readily. The levels of phosphide and respirable dust were reasonably low in the elevators, suggesting that the ventilation system was adequate. The author recommends that workers filling the dispenser with the aluminum phosphide be required to wear personal protective equipment during the operation.

35597 (PB—87-163119/XAB) Industrial hygiene walk-through survey report of BASF Corporation - Inmont Division, Cincinnati, Ohio. McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). 27 Oct 1986. 21p. (IWS—157.13). NTIS, PC A02/MF A01.

The potential for employee exposure to acrylates or methacrylates was investigated by a walk-through industrial-hygiene survey at the Inmont facility of BASF Corporation, Cincinnati, Ohio. Radiation-curable coatings and ink vehicles have been produced at this facility for the previous 7 years. Coatings are formulated in a mixing tank with a high-speed agitator. Two enclosed reactors were used to formulate the ink vehicles. The work force is composed of 205 employees, 41 of whom function in areas where exposure to the suspect chemicals is likely. No industrial hygiene data for multifunctional acrylates had been collected and no illnesses attributable to the chemicals have been reported at the facility. There is a structured medical program at the facility with a safety program and a general industrial-hygiene program. Adequate personnel records were have been kept for all employees. No recommendations were considered necessary.

35598 (PB—87-163127/XAB) Industry-wide studies report of a walk-through survey of the H. W. Andersen Products Company, Incorporated, Oyster Bay, New York. Industry-wide study. Elliott, L.J.; Stayner, L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Aug 1986. 16p. (IWS—67.44). NTIS, PC A02/MF A01.

The possibility of including the H.W. Anderson Products Company in an industrywide study report on possible worker exposure to ethylene oxide (Et0) was considered. The facility housed an Anprolene ampule-filling operation, a remote Et0 storage area, and product packaging and storage areas. Sterilizer equipment was also manufactured at the facility and there was a machine shop and plastics molding area for patient-care products (body-cavity drainage pumps and drainage tubing). Et0 was used to sterilize these products before final packaging. Respirators were required to be worn

in some areas and job operations. While the employees were instructed in the use of the individual respirator, no fit testing, formal training, or maintenance program for the respirator units was carried out. Due to the lack of personnel records, the authors recommend that this facility not be included in the Et0 mortality study.

35599 **(PB—87-163200/XAB) Health-hazard evaluation report HETA 80-035-1635b, Bofors-Nobel/Lakeway Corporation, Muskegon, Michigan (revised).** Handke, J.L.; Lee, S.A.; Patnode, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1986. 30p. (HETA—80-035-1635). NTIS, PC A03/MF A01.

The International Chemical Workers Union requested an evaluation of dermatitis and reproductive system disorders among workers exposed to oryzalin, dichlorobenzidine (DCB), and benzidine at the Bofors-Nobel/Lakeway facility, Muskegon, Michigan. Exposure to DCB was measured from two personal breathing samples and the results ranged from not detectable to 6.5 micrograms/cubic meter mcg/cu m. Area samples for DCB were also taken. Surface-contamination samples revealed DCB on the packout locker-room surfaces and inside the operator's personal-protective equipment. Exposure to airborne oryzalin for six full-shift workers ranged from not detectable to 130mg/cu m, with a mean of 28mcg cu m. Dinitrochlorobenzene (DNCB) was detected in air at 70mcg/cu m and on surfaces at 6mcg/100 cm^2. Workers exposed to oryzalin reported no adverse reproductive effects. Of 36 workers exposed to DNCB, 19 had skin problems. Bladder cancer was documented in 10 workers with a mean time from first exposure to benzidine to diagnosis of 13.3 years. The authors conclude that a potential hazard existed from dichlorobenzidine exposure. The authors recommend improved housekeeping explanation of the medical-surveillance program to all workers, and continuation of the bladder cancer screening program.

35600 **(PB—87-163218/XAB) Numerical study of the response of the Southern Ocean and its sea ice to a CO_2-induced atmospheric warming.** van Ypersele, J.P. (National Center for Atmospheric Research, Boulder, CO (USA)). 1986. 153p. (NCAR/CT—99). NTIS, PC A08/MF A01.

A comprehensive coupled model of ocean circulation and sea ice has been developed to study a selected area of the Southern Ocean that includes the Weddell Sea and the Drake Passage. An existing general circulation model of the ocean was configured for the geometry of the Southern Ocean domain and then improved by including robust-diagnostic forcing and allowing for coupling to a sea-ice model. When the model was initially tested without coupling, the ocean circulation corresponded well with the observed circulation. In addition, a dynamic–thermodynamic model of sea ice was developed and tested with a constant upward oceanic heat flux. The results of two simulations made with the sea-ice model, with and without transport and dynamics, show that thermodynamics is insufficient to explain the large amplitude of the seasonal cycle of ice extent, and that the inclusion of transport and parameterized dynamics is essential for the reproduction of the observed cycle.

35601 **(PB—87-163234/XAB) Health hazard evaluation report HETA 85-039-1723, E. L. Smithe Machine Company, Duncansville, Pennsylvania.** Bennett, D.E. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1986. 35p. (HETA—85-039-1723). NTIS, PC A03/MF A01.

The International Association of Machinists Local 2348 requested an investigation of reported skin rashes and headaches associated with cutting and cooling oils and solvents used in the machine shop. Of 62 employees interviewed, 42 had experienced skin problems occurring on their hands and arms including red skin, dry skin, cracked skin, or itchy skin, related to chemical exposures at the workplace. Xerosis, lichenification, or eczema of the hands and arms were noted on examination of 17 employees of the Lathe Department and 18 of those from the Milling Department. Respiratory and neurological complaints were also found among these employees. The author concluded that the incidence of hand and arm xerosis and eczema in workers in the machining area may be associated with exposure to cutting oils. The author recommends that changes be made to minimize skin exposure and provide adequate ventilation and humidification.

35602 **(PB—87-163259/XAB) Health-hazard evaluation report HETA 84-371-1729, Orbitron Products, Delphos, Ohio.** London, M.A.; Lee, S.A.; Smith, A.B.; Kopp, S.; Bascom, R. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 60p. (HETA—84-371-1729). NTIS, PC A04/MF A01.

The United Auto Workers requested an investigation be made of respiratory-system complaints at Orbitron Products, Delphos, Ohio. Industrial, home, and automotive products were manufactured at the facility by approximately 80 employees. Ethyl-cyanoacrylate was the primary chemical to which exposure was possible, but there was also concern about methyl-ethyl-ketone (MEK) exposure.

35603 **(PB—87-163382/XAB) Health-hazard evaluation report HETA 81-372-1727, Exxon Corporation, Bayway Refinery and Chemical Plant, Linden, New Jersey.** Liveright, T.; Gann, P.; McAna, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 41p. (HETA—81-372-1727). NTIS, PC A03/MF A01.

A representative of Teamsters Local 877 requested an evaluation of the hazards of asbestos exposure at the Exxon Bayway Refinery and Chemical Plant, Bayway, New Jersey. Asbestos was extensively used for insulation at this facility before 1972. Chest x-rays of retired and current workers with at least 20 years employment at the facility were reviewed and the relationship of work history to asbestos related x-ray abnormalities was investigated. Oil-refinery and petrochemical workers examined showed several abnormalities on chest x-rays. Pleural abnormalities were more prevalent than parenchymal ones. Abnormal chest x-rays were found among workers from various job categories, suggesting that exposures were dispersed and widespread. There was a general relationship between length of employment and the appearance of x-ray abnormalities. The authors conclude that there is a possibility of increased risk of lung cancer and mesothelioma in exposed workers.

35604 **(PB—87-163390/XAB) Health-hazard evaluation report HETA 85-455-1724, Champion International, Frenchtown, Montana.** Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 15p. (HETA—85-455-1724). NTIS, PC A02/MF A01.

Possible exposures to crystalline silica, lead and total particulates were reviewed at Champion International, Frenchtown, Montana, in response to a request by the Hellgate Local 885 of the United Paperworkers International Union. The hog-fuel and waste fuel boilers were the areas of specific concern at this paper mill. Breathing zone samples collected for nine locations were found to be below the evaluation criteria for crystalline silica and total-particulate contents. Respirable silica was present at 0.02mg/cm^3 at its highest concentration. Respirable particulate concentrations ranged from 0.2 to 11.0, with an average concentration of 4.12mg/cm^3. The author concludes that a potential health hazard existed from exposure to total dust in the boiler area, and from installation of asbestos gasket material. Workers involved in handling the gasket material should be advised that it is made of asbestos and take the required safety precautions. The asbestos gasket material should be replaced by some less-hazardous material.

35605 **(PB—87-163408/XAB) Health-hazard evaluation report HETA 86-375-1735, Primary Childrens Hospital, Salt Lake City, Utah.** Gunter, B.J.; Reno, S.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 17p. (HETA—86-375-1735). NTIS, PC A02/MF A01.

A request was received from the Department of Surgery at Primary Childrens Hospital to investigate exposures in operating rooms and recovery room for nitrous oxide, ethrane, halothane, and isoflurane. The NIOSH criteria of 0.5 parts per million (ppm) was exceeded for ethrane in 17 of 24 air samples, 71%. The 0.5ppm criteria for halothane was exceeded in 13 of 24 samples, 54%. The 0.5ppm criteria for isoflurane was exceeded in 2 of 24 samples, 8%. Nitrous oxide was examined in 32 air samples taken from workers, and in 31 of these the concentration exceeded the criteria of 25ppm. All operating rooms exhibited excessive exposures to ethrane, halothane, isoflurane and nitrous oxide due to a lack of sufficient air

changes per hour. These levels would be significantly lower if adequate ventilation was provided. The method of administering anesthetics differs in this children's hospital from an adult situation. The authors recommend that the slip connections and high-pressure nitrous oxide connections be checked by the anesthesiologist. An air-monitoring system must be in use at all times. Increased ventilation is recommended.

35606 **(PB—87-163424/XAB) Assessment of dust-control technology for selected ceramic production processes.** Godbey, F.W.; Caplan, P.E.; Cooper, T.C.; McKinnery, W.N.; Mahon, R.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jul 1984. 86p. (ECTB—110-04). NTIS, PC A05/MF A01.

Surveys of dust-control technology for selected ceramic industrial processes at four facilities were conducted. The first site involved crushing and grinding of pyrophyllite ore to production specifications for wall and floor tiles. Exposures to dust were maintained below OSHA standards by isolation of major dust-producing operations, enclosure and ventilation of processing and transfer equipment, and good-housekeeping practices. The second site involved crushing of ball clay and shale for the quarry wall and floor tile industry. Personal samples averaged 106% of the OSHA standard for respirable dust and 361% for total dust. Inadequate planning and maintenance of local-ventilation systems were considered responsible for the high dust concentrations. The third site involved finish grading of tile in the quarry wall and floor-tile industry. Dust exposures were held below OSHA standards by the use of local exhaust ventilation on all grinding machinery. The fourth site involved batching, mixing, and packaging of ceramic materials. Dust exposures were kept below OSHA standards by enclosure and ventilation, good housekeeping, and a personal protective-equipment program.

35607 **(PB—87-163465/XAB) Health-hazard evaluation report HETA 84-534-1721, Defense Industrial Supply Center, Philadelphia, Pennsylvania.** Bennett, D.; Chorstek, W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1986. 28p. (HETA—84-534-1721). NTIS, PC A03/MF A01.

Management of the Defense Industrial Supply Center, Philadelphia, Pennsylvania, requested an evaluation of possible excess cancer deaths and respiratory problems encountered among employees. Measurements were taken for carbon dioxide, carbon monoxide, temperature, relative humidity, organic vapors, and airborne dust. Sample materials were taken of insulation, solvent cleaners, and carbonless paper used at the facility. The area of work in which excess cancer-related deaths may have occurred involved primarily computer work, central communications, and data-processing operations. Chemical exposure occurring in the facility included solvent tape-drive cleaner in the computer tape library, inks used by printers, and an ammonia-based developer fixer used in the microfiche area.

35608 **(PB—87-163747/XAB) In-depth survey report: control technology assessment of enzyme fermentation processes at Gist-Brocades USA, Incorporated, Kingstree, South Carolina.** Martinez, K.F.; Sheehy, J.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 39p. (ECTB—116-19B). NTIS, PC A03/MF A01.

The controls and containment capabilities of the proteolytic-enzyme manufacturing process was examined at the Gist-Brocades USA, Inc., facility located in Kingstree, South Carolina, where 160 workers were involved in the production of the industrial enzyme protease using a microbial strain of Bacillus subtilis. A comparison between viable sample concentrations at selected sites and background levels indicated that most emissions occur at high-energy operations including the agitator shafts, belt conveyor, filter press, and sampling ports. Exhaust gases from the fermentor and seed tanks were also sites of increased emission levels, as the water scrubber did not completely control the release of entrained production microorganisms. During removal of the filter cake from the filter press, the microbial levels ranged as high as 28990 colony forming units/cubic meter in a single sample. In all but one location of the enzyme recovery area, acetone levels were less than 0.01/ccm. Emissions from sampling ports could be lowered by following the company procedure for opening the steam valve.

35609 **(PB—87-163762/XAB) Health-hazard evaluation report HETA 85-031-1706, National Starch, Indianapolis, Indiana (revised).** Almaguer, D.; London, M.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 20p. (HETA—85-031-1706). NTIS, PC A02/MF A01.

A request for an investigation of pulmonary and cardiovascular disease was received from the National Starch and Chemical Corporation, Indianapolis, Indiana. In a survey in March 1985, concentrations of hydrochloric acid, sulfuric acid, sodium hydroxide, propylene oxide, and total and respirable starch dust were all below acceptable limits. In the Wet Mill, samples were taken of sulfur dioxide (SO_2) which indicated exposure levels ranging from 1.7 to 2.4 parts per million, in excess of the NIOSH recommended exposure limit (REL) of 0.5 ppm. The authors conclude that workers at this facility were exposed to sulfur dioxide concentrations in excess of the NIOSH REL. Recommendations include installation of effective engineering controls, improved employee work practices, the use of respiratory protection to decrease SO_2 exposure, proper maintenance of equipment, good housekeeping practices, and comprehensive, annual medical examinations for all employees exposed to SO_2.

35610 **(PB—87-163887/XAB) In-depth survey report: control technology for ethylene oxide sterilization in hospitals at Wooster Community Hospital, Wooster, Ohio.** Kercher, S.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1985. 37p. (ECTB—146-15B). NTIS, PC A03/MF A01.

An in-depth survey of control technology for ethylene oxide sterilization in the Central Services Department was conducted at Wooster Community Hospital, Wooster, Ohio, in February 1985. Industrial-hygiene sampling for ethylene oxide was performed. Engineering controls consisted of isolation of the sterilizers and aerators, general ventilation, and door controls for the load-transfer operation. All full-shift personal and area ethylene-oxide exposures were below 0.005 and 0.2 part per million (ppm), respectively. The OSHA time-weighted average (TWA) standard for ethylene oxide is 1 ppm. The author concludes that engineering controls work very well in limiting exposures and maintaining low ethylene oxide concentrations. Recommendations include installing alarm devices on the ventilation systems, increasing the exhaust flow rate in the hoods over the sterilizer doors, and relocating the evacuation line from the sterilizers to prevent possible reentry of ethylene oxide to the building.

35611 **(PB—87-163895/XAB) Health-hazard evaluation report HETA 86-222-1726, Grundy Industries, Inc., Denver, Colorado.** Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 12p. (HETA—86-222-1726). NTIS, PC A02/MF A01.

Management personnel of Grundy Industries located in Denver, Colorado requested an investigation of their facility with regard to possible asbestos exposure. At this facility a roofing compound was manufactured, composed of approximately 1.3 pounds of asbestos to each gallon of asphalt. Four breathing-zone and two general-room air samples for asbestos gave results that were all below the NIOSH recommended level of 0.1 fibers/cm^3. Polynuclear aromatics were determined in general room air samples.

35612 **(PB—87-163903/XAB) Health-hazard evaluation report HETA 85-372-1728, Bendix Cheshire Corporation, Cheshire, Connecticut.** McManus, K.P.; Ehrenberg, R.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 19p. (HETA—85-372-1728). NTIS, PC A02/MF A01.

Service Employees International Union requested an investigation at the Bendix Cheshire Corporation located in Cheshire, Connecticut regarding possible employee exposure to solvents, specifically Freon and 1,1,1-trichloroethane. Gas and electric gyros were manufactured on the premises.

35613 **(PB—87-163929/XAB) Health-hazard evaluation report HETA 82-181-1720, Ford Motor Company, Utica, Michigan.** Gamble, J.; Kellie, S.; Petersen, M.; Hodgson, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1986. 69p. (HETA—82-181-1720). NTIS, PC A04/MF A01.

Exposure to toluene-diisocyanate (TDI) at the Utica Trim Facility was evaluated following a request by the UAW. TDI was used in the manufacture of polyurethane automotive seat cushions, backs, and head rests. A total of 261 workers from the facility and a comparison group of 207 workers from a tractor factory were surveyed. There had been six spills of TDI, but concentrations of TDI did not exceed the NIOSH ceiling of 20 parts per billion (ppb). Paper-tape records for 42 pouring stations over the period from 1976 to 1981 indicated that at two stations the ceiling was exceeded and at eight the concentrations were at or above the 8-hour NIOSH recommended time-weighted average of 5ppb. No excessive exposures to TDI were found on the foam-line processes with the exception of the pouring-station enclosures. The authors recommend enforcement of the use of respirator equipment at the pouring stations. Better control of dust in the trimming and repair areas will also serve to reduce the irritation to the eye and respiratory system.

35614 **(PB—87-163937/XAB) Carbon tetrachloride/carbon disulfide exposures in grain fumigation. Final report.** Marano, D.E.; White, K.L.; Deer, H.; Alexander, G. (Utah Univ., Salt Lake City (USA)). Mar 1986. 115p. NTIS, PC A06/MF A01.

The use of 80/20 compounds as liquid-fumigant mixtures in the grain-handling industry was considered. Worker exposures to carbon tetrachloride and carbon disulfide were measured at representative facilities throughout the industry. Work practices that may contribute to high exposure levels were cited. Approximately equal amounts of liquid fumigants and solid formulations of phosphine are used throughout the industry. As spraying is done on a sporadic basis, it does not appear likely to present a major problem such as might be encountered in continuous exposure situations. The authors conclude that grain workers do not appear to be an ideal study group for a neurotoxicity morbidity study due to the fact that the physical distance between study sites and the small number of workers at each site makes it difficult logistically. A concerted effort throughout the grain industry to educate those workers in the grain-handling portions of that industry toward the safe handling of fumigants should go far in alleviating any problems arising from exposure to fumigants.

35615 **(PB—87-164174/XAB) Health-hazard evaluation report HETA 86-184-1719, AMTRAK, Long Island City, New York.** Hartle, R.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1986. 22p. (HETA—86-184-1719). NTIS, PC A02/MF A01.

The International Brotherhood of Electrical Workers Local 817 requested a study be made to determine the potential exposure of workers at the Engine House associated with the AMTRAK New York Maintenance Facilities, Long Island City, New York to polychlorinated biphenyls (PCBs). Full shift breathing zone and environmental air samples were collected.

35616 **(PB—87-164182/XAB) Industrial hygiene walk-through survey report of Lord Corporation, Chemical Products Group, Sagertown, Pennsylvania.** McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). 20 Nov 1986. 19p. (IWS—157.10). NTIS, PC A02/MF A01.

In order to determine possible occupational exposure to acrylates or methacrylates at the Saegertown facility of Lord Corporation located in Saegertown, Pennsylvania, a walk through industrial hygiene survey was conducted. Radiation-curable coatings are produced at the facility along with oligomers containing multifunctional acrylates. The facility employed 162 workers at the time of the survey. One case of illness due to the use of multifunctional acrylates was reported in the past 2 years. This was due to a spill of a small quantity of radiation-curable coating on the shoes of a dispersion equipment operator, and the subsequent development of blisters on the tops of both feet. The authors note that the wearing of spats on shoes may protect against spills when handling acrylates.

35617 **(PB—87-164208/XAB) Health-hazard evaluation report HETA 86-236-1725, San Francisco Opera Costume Shop, San Francisco, California.** Belanger, P.L.; Okawa, M.T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 24p. (HETA—86-236-1725). NTIS, PC A02/MF A01.

An employee representative of the San Francisco Opera Costume Shop requested an investigation of possible exposure to chemical substances by crafts persons and textile artists. No overexposure to chemicals was found during cloth stripping and dying operations, boot deglazing, hat lacquering, fabric painting or casting operations. During boot spray painting, two personal air samples contained methylene chloride at 11.9 and 25 parts per million; both above the NIOSH recommended criteria for methylene-chloride exposure.

35618 **(PB—87-164216/XAB) Industrial-hygiene walk-through survey report of Adhesives and Graphics Division, Division of Borden Chemical, Borden, Incorporated, Cincinnati, Ohio.** McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). 17 Oct 1986. 15p. (IWS—157.14). NTIS, PC A02/MF A01.

A walk-through survey was conducted at the Borden Chemical facility of Borden, Inc. in Cincinnati, Ohio, to investigate the potential for worker exposure to acrylates or methacrylates. The facility produces ultraviolet-curable coatings and inks. Medical, safety, and industrial hygiene programs at the facility were investigated. Several cases of skin rash were reported at the facility and these were attributed to exposure to the multifunctional acrylates. Safety meetings concerning the chemicals at the facility were held frequently in conjunction with the employee right-to-know laws. All employees were supplied with safety glasses, hard hats, and protective clothing of pants and shirts. Safety shoes were worn in the production areas. In addition, the coating operators wore disposable coveralls. Scott air packs were used when cleaning up spills in the coatings area. Showers and changing areas were available. Based on the observations of this walk-through survey, the authors considered no recommendations to be necessary at this time.

35619 **(PB—87-164232/XAB) Mortality in workers in electromechanical and electronics production.** Park, R.; Silverstein, M.; Maizlish, N.; Robins, T.; Mirer, F. (International Union, United Automobile, Aerospace and Agricultural Implement Workers of America, Washington, DC). 16 Jul 1986. 76p. NTIS, PC A05/MF A01.

Concern expressed by a local union over excess cancer deaths at an electronics and electromechanical manufacturing facility for aircraft and missile applications prompted this mortality study. Chemical exposures included halogenated solvents, cutting fluids, solder fluxes, epoxy resins, cyanoacrylate resins, and acrylonitrile-based resins. From 1965 to 1979 there were 30 deaths from cancer among female workers; 15.5 was the expected number. From 1970 to 1979 there appeared to be significant excess proportions of deaths attributable to pancreatic cancer in men and women and of colon cancer, stomach cancer and ovarian cancer in women. From 1980 through 1983, there has been no evidence of increased cancer; however, the numbers are small. The authors recommend that an independent hygiene assessment be made of current production, paying strict attention to ventilation systems, resin handling systems, solvent use, and cutting fluid control in the grinding and maching operations. The establishment of a hazardous-materials control committee is recommended.

35620 **(PB—87-164273/XAB) Study of the prevalence of chronic, non-specific lung disease and related health problems in the grain-handling industry. Technical report.** Rankin, J.; Bates, J.; Claremont, A.; Dennis, W.; doPico, G.A. (Wisconsin Univ., Madison (USA)). Oct 1986. 363p. NTIS, PC A16/MF A01.

A total of 310 grain handlers was studied, with attention to prevalence and characteristics of clinical, psychological, immunolo-

gical, radiological, serological blood and urine parameters to determine any apparent effects from grain-dust exposure. Grain handlers had a higher prevalence of respiratory symptoms and signs than did the city workers who comprised the comparison group. Evidence of accumulative respiratory effect due to recurring exposures to grain dust was found. Acute and chronic airway reactions were induced by exposure to grain dust. Wheezing and dyspnea on exposure were related to length of employment. Grain fever syndrome was prevalent. Cases of acute recurrent conjunctivitis and rhinitis were found along with skin pruritus, mainly on exposure to barley dust. Pesticide exposure caused temporary disabling symptoms. Lung function was adversely affected by grain-dust exposure. Exposure to grain mites and insects in contaminated cereal grain caused a reaction among grain workers.

35621 **(PB—87-164349/XAB) Industry-wide studies report: a walk-through survey of Bristol-Myers Company, Industrial Division, Syracuse, New York.** Stayner, L.; Morawetz, J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Dec 1986. 30p. (IWS—67.42). NTIS, PC A03/MF A01.

A walk-through survey was conducted at the Bristol-Myers Company (SIC-2834) located in Syracuse, New York to investigate the feasibility of including this facility in the NIOSH mortality study of ethylene oxide (EtO) hazards in the workplace. At this facility pharmaceuticals were manufactured along with emergency medical kits. Departments covered are: Biological Emergency Medical System; Microbiological Control Department; Pharmaceutical Bulk Department; Product Development Department; Sterile Filling Department; Molloy Road Warehouse; Fermentation Development Laboratory; Plant Process Analysis Laboratory. This facility failed to meet the requirements for inclusion in the larger study, based on the presence of potential leukemogens such as benzene and antineoplastic compounds in several departments and the inadequacy of the personnel records to identify workers potentially exposed to EtO in the other departments.

35622 **(PB—87-164398/XAB) Industry-wide studies report of walk-through survey of Schilling, McCormick and Company, Incorporated, Salinas, California.** Morawetz, J.; Steenland, K. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). Nov 1986. 21p. (IWS—67.50). NTIS, PC A02/MF A01.

A walk-through survey was conducted to determine the suitability of including Schilling, McCormick and Company, Salinas, California, in an industry-wide mortality and industrial hygiene study concerning workers with potential exposure to ethylene oxide. At this facility, spices are ground, milled, blended, mixed and filled for various customers. Et0 is used to treat unprocessed poppy seeds and Brazilian pepper as they arrive at the facility. Other spices are treated when necessary. A review of personal data on exposure levels showed that jobs where workers are exposed to 1 part per million or greater on the average include bottle dumper, receiving clerk, safety supervisor, forklift driver at warehouse, forklift driver at receiving, and Et0 chamber operator. Medical, industrial hygiene, and safety programs in effect at the facility were examined. The authors concluded that this facility meets the requirements for entry into the larger study; however, due to the limited number of person years (3000) at this facility compared to others in the study, and the cost of data collection and coding, the decision was made not to include this facility.

35623 **(PB—87-164414/XAB) Walk-through survey report: HVLV (high velocity low volume) control technology for aircraft bonded wing and radome maintenance at Air Force Logistics Command, McClellan Air Force Base, Sacramento, California.** Hollett, B.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Aug 1983. 8p. (ECTB—145-18A). NTIS, PC A02/MF A01.

A walk through survey was conducted at the Sacramento Air Logistics Center, McClellan Air Force Base, California, on June 13, 1983, to evaluate the use of High Velocity Low Volume (HVLV) technology in the aircraft-maintenance industry. The HVLV system consisted of 65 ceiling drops in the bonded honeycomb shop where grinding and sanding operations created glass fiber and resin dusts. Preemployment and periodic physical examinations were required. Workers were required to wear disposable coveralls, and disposable dust masks were available. Workers walked through decontamination air jet showers before leaving the area to change clothes. Environmental monitoring revealed no significant dust exposures when the HVLV system was in use. Performance of the exhaust system on the eight-inch-diameter nose cone sanding operation was good, but the three-inch-diameter tools were too large and the shrouds too cumbersome for use on many hand-finishing tasks. The author concludes that the HVLV system is partially successful but requires additional shroud design. Further development of small tool shrouds is recommended.

35624 **(PB—87-164422/XAB) Airliner cabin environment: air quality and safety. Final report.** (National Research Council, Washington, DC (USA)). Aug 1986. 320p. NTIS, PC A14/MF A01.

The report discusses the adequacy of air quality and standards aboard commercial aircraft for the health and safety of all who fly. Addressed are aspects of cabin air such as the quantity of outside air, the quality of onboard air, the extent of pressurization, the characteristics of humidification, the presence of cosmic radiation, contaminants (such as bacteria, fungi, and other microorganisms), and pollutants (such as environmental tobacco smoke, carbon monoxide, carbon dioxide, and ozone) that could be responsible for health problems in the long or short run. It recommends some remedies for problems discovered, and outlines the safety precautions necessary to protect passengers in the event of in-flight fires which produce smoke and fumes.

35625 **(PB—87-164463/XAB) In-depth survey report: control technology assessment of enzyme fermentation processes at Miles Laboratories, Inc., Elkhart, Indiana.** Sheehy, J.W.; Martinez, K.F. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1986. 37p. (ECTB—116-166). NTIS, PC A03/MF A01.

The controls and containment capabilities of the carbohydrase enzyme manufacturing process were evaluated at the Miles Laboratories, Inc. facility located in Elkhart, Indiana. The enzyme alpha-amylase has been produced at this facility since March of 1982. One specific unit process showed results significantly above the background levels, that being the centrifuge. At the vacuum-filter knife edge, the viable levels were higher than background, but even within a few feet of the vacuum-filter belt they were reduced below background levels. Levels were not significantly above background at the fermentor agitator shaft, seed fermentor agitator shaft, and fermentor sample port. The clean room had background levels significantly below the levels in the laboratory. Apparently the overall effective containment of the production organisms used is very good. Measures of total dust levels indicated these were far below the threshold limit value of 10mg/cu m.

35626 **(PB—87-164497/XAB) In-depth survey report: control technology for ethylene oxide sterilization at Euclid General Hospital, Euclid, Ohio.** O'Brien, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1985. 32p. (ECTB—146-14B). NTIS, PC A03/MF A01.

An indepth survey of control technology for ethylene oxide sterilization was conducted. Industrial hygiene sampling for ethylene-oxide was conducted. Engineering controls consisted of local exhaust ventilation above the sterilizers, at the drain, at the safety relief valve, and around the ethylene-oxide cylinders, general ventilation, and use of a pulse/purge phase at the end of the sterilization cycle. A three-component ethylene-oxide monitoring program was in place, consisting of continuous monitoring with an alarm system, environmental area monitoring performed by an outside contractor, and exposures were below 0.2 part per million. The OSHA time weighted average (TWA) standard for ethylene oxide is 1 ppm. Proper work practices for employees were outlined in a procedure and policy manual. The Central Services Director provided education and training on proper work practices and the hazards of ethylene-oxide exposure. The author concludes that the engineering controls at the facility successfully minimize employee exposure to ethylene oxide.

35627 **(PB—87-164505/XAB) In-depth survey report of Early and Daniel Co., Inc., Louisville, Kentucky.** Zaebst, D.D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 29p. (IWS—149.12). NTIS, PC A03/MF A01.

An in-depth industrial hygiene survey was conducted to evaluate worker exposures to phosphine during fumigation of grain at the Early and Daniel Co. grain elevator in Louisville, Kentucky. Stored grain was fumigated using aluminum phosphide. Aluminum-phosphide pellets were also added directly to the grain by the blender as it was poured into the storage containers. Local exhaust ventilation was used at points in the grain-moving system where grain dust was generated. Air samples were taken during full-shift periods at the breathing zone of the weighmaster, two bin floormen, and the blender. Area monitoring samples were also taken. If the operators spend considerable time in the vicinity of a bin which is being filled with grain, there is a likelihood of far greater exposure levels being noted. According to the author, further studies of the use of phosphide products at other elevators should be conducted to determine the effect of environmental and process parameters on phosphine exposures.

35628 **(PB—87-164513/XAB) In-depth survey report: control technology for ethylene oxide sterilization at Bethesda Hospital, Cincinnati, Ohio.** Mortimer, V.D.; Kercher, S.L. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1985. 36p. (ECTB—146-11B). NTIS, PC A03/MF A01.

An indepth survey of control technology for ethylene oxide sterilization was conducted at Bethesda Hospital, Cincinnati, Ohio, in June 1984. Industrial hygiene sampling for ethylene oxide was performed. Preventive maintenance on the sterilization equipment was performed by an outside contractor. Some personal monitoring for ethylene oxide, averaging once a year, was conducted. It was noted that the operators manually transferred items from the sterilizer cart into the aerator. The authors conclude that full-shift and short-period exposures to ethylene oxide are well controlled. The exposures to the sterilizer operators can be controlled further by their not manually lifting the items from the sterilizer cart into the aerator. Sensors and alarm devices should be installed on the ventilation systems.

35629 **(PB—87-165262/XAB) Intercomparison of sampling techniques for toxic organic compounds in indoor air. Final report, March 1985-September 1986.** Spicer, C.W.; Holdren, M.W.; Slivon, L.E.; Coutant, R.W.; Shadwick, D.S. (Battelle Columbus Div., OH (USA)). Mar 1987. 146p. NTIS, PC A07/MF A01.

People spend a major fraction of their time indoors, and there is concern over exposure to volatile organic compounds present in indoor air. The study was initiated to compare several VOC sampling techniques in an indoor environment. The techniques which were compared include distributive air volume sampling, high- and low-rate passive sampling, and whole air collection in canisters. The study focused on ten target compounds: chloroform, 1,1,1-trichloroethane, benzene, bromodichloromethane, trichloroethylene, toluene, tetrachloroethylene, styrene, p-dichlorobenzene, and hexachlorobutadiene. Altogether, ten separate 12-hour sampling experiments were conducted. Two experiments sampled the background air of the residence. For the other eight experiments, the indoor air was spiked with the target compounds. Statistical analysis of the results indicates generally high correlation coefficients (greater than 0.90) between the methods. The most notable exception was benzene, which had lower correlation coefficients. In general, the distributed air volume sampling technique measure concentrations less than or equal to the canister method.

35630 **(PB—87-166211/XAB) Receptor modeling study of Denver winter haze.** Lewis, C.W.; Baumgardner, R.E.; Stevens, R.K.; Russwurm, G.M. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 13p. (EPA—600/J-86/262). NTIS, PC A02/MF A01.

Pub. in Environmental Science and Technology, Vol. 20, No. 11, 1126-1136(Nov 1986).

A multiple-regression single-element tracer method was used to estimate source contributions to fine and coarse aerosol mass and light extinction, measured in Denver during January 1982. Motor vehicles were the largest contributor to average fine particle mass (42%) and daytime light extinction (47%). Electric-power generation was next largest, at 23% and 44%, respectively. Estimates were generally similar to those of the comprehensive field study conducted by General Motors Research Laboratory in late 1978, but with a somewhat enhanced motor-vehicle contribution compared with the 1978 results. Notable differences from the 1978 results included a reduced value for b(sup ap)/b(sub sp) (0.24), a reduced value for the ratio of elemental carbon to fine-particle carbon (0.23), and an absence of non-sulfate sulfur in the fine-mass fraction. The differences are in the direction of lessening the distinctiveness of Denver relative to other U.S. airsheds.

35631 **(PB—87-166229/XAB) Intercomparison of high-volume PM10 samplers at a site with high-particulate concentrations.** Purdue, L.J.; Rodes, C.E.; Rehme, K.A.; Holland, D.M.; Bond, A.E. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). 1986. 6p. (EPA—600/J-86/260). NTIS, PC A02/MF A01.

Pub. in Jnl. of Air Pollution control Association, Vol. 36, No. 8, 917-920(Aug 86).

Commercially available high-volume PM10 samplers were intercompared at a site in Phoenix characterized by high concentrations of coarse particles. Over a 21-day period, Sierra Andersen 321A (SA 321A) samplers gave PM10 measurements 58% higher than the Wedding IP10 (WED) samplers and 16% higher than a SA 321A sampler that had an oil coating on the internal impaction surfaces of the inlet. WED samplers that were subjected to a simple brush-cleaning procedure after each sampling period gave PM10 results 16% higher than the WED samplers not subjected to cleaning. The oiled SA 321A sampler gave PM10 values 15% higher than the cleaned WED samplers. The results demonstrate that the SA 321A overestimates PM10 when sampling in an environment with high coarse-particle concentrations. The over collection results from pass-through of large particles, and can be minimized by oiling the internal impaction surfaces of the inlet. The WED sampler underestimates PM10 after several days of sampling in such an environment.

35632 **(PB—87-166351/XAB) Comparative characterization of organic emissions from diesel particles, coke oven mains, roofing tar vapors, and cigarette smoke condensate.** Williams, R.; Sparacino, C.; Petersen, B.; Bumgarner, J.; Jungers, R.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 25p. (EPA—600/J-86/270). NTIS, PC A02/MF A01.

Pub. in International J. of Environmental Analytical Chemistry, Vol. 26, 27-49(1986).

The paper reports the characterization of the extractable organics from diesel particle emissions compared to other complex organics which have been reported to increase the risk of human lung cancer. Class fractions of diesel, cigarette smoke condensate, roofing tar, and coke oven extracts were obtained using liquid/liquid partitioning and silica gel chromatography. Capillary GC/MS was used to identify compounds in each extract fraction. The manuscript reports the mass distribution after fractionation of each extract, all identified fraction components and quantification of selected mutagenic and carcinogenic compounds.

35633 **(PB—87-166583/XAB) EAB (Economic Analysis Branch) control cost manual (third edition).** Vatavuk, W.M.; Jenkins, R.E.; Katari, V.S.; Klotz, W.L.; McKenna, J.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Feb 1987. 184p. (EPA—450/5-87/001A). NTIS, PC A09/MF A01.

Supersedes PB—80-157282.

The report provides design procedures and current cost data for commonly used add-on air pollution control devices and auxiliary equipment. It supersedes two EPA reports, both entitled Capital and Operating Costs of Selected Air Pollution Control Systems: EPA-450/3-76-014 (May 1976) and its revision, EPA-450/5-80-002 (December 1978). This issuance of the Manual contains five sections. Sections 1 (Introduction) and 2 (Manual Estimating Method-

ology) present, respectively, introductory material and a comprehensive, general procedure for developing study (+ or - 30% accurate) control cost estimates. Sections 3 to 5 discuss the applications, design, and cost-estimating procedures and data for thermal and catalytic incinerators, carbon adsorbers, and fabric filters, respectively. This issuance of the Manual will be followed by others as more sections are completed.

35634 **(PB—87-166963/XAB) Review of NMOC, NOx and NMOC/NOx ratios measured in 1984 and 1985.** Baugues, K. (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Sep 1986. 86p. (EPA—450/4-86/015). NTIS, PC A05/MF A01.

During the summers of 1984 and 1985, morning (6-9AM) measurements of ambient nonmethane organic compounds (NMOC) were collected at 22 and 19 urban sites, respectively. The data were collected by State and local agencies which contributed grant funds and personnel. The Environmental Protection Agency (EPA) managed the analysis and provided NMOC sampling equipment. The method of determining NMOC levels was the cryogenic preconcentration direct flame-ionization detection (PDFID) described by McElroy. Data were collected to provide input values for the Empirical Kinetic Modeling Approach (EKMA), a computer program which estimates hydrocarbon control requirements necessary to attain the National Ambient Air Quality Standard (NAAQS) for ozone. One of the key inputs to EKMA is the Nonmethane Organic Compound/Nitrogen Oxides (NMOC/NOx) ratio. Thus, a collocated NOx instrument was operated at each NMOC site.

35635 **(PB—87-167003/XAB) Comparison of numerical and laboratory experiments on density-stratified flows around a three-dimensional hill.** Rottman, J.W.; Lawson, R.E.; Snyder, W.H. (North Carolina State Univ., Raleigh (USA)). Mar 1987. 14p. NTIS, PC A02/MF A01.

Direct comparisons between the results of a numerical model and laboratory experiments are presented for density-stratified flows around an isolated three-dimensional hill. The numerical model integrates the Navier-Stokes equations for incompressible stratified flow using a finite-difference scheme. Numerical calculations were made for Reynolds numbers (based on the hill height) of 100 and 400 and for Froude numbers between 0.5 and 2 as well as for neutrally stratified flow. The laboratory experiments were performed in a small (2.1m long) stratified towing tank, a large (25m long) stratified towing tank, and a meteorological wind tunnel. Experimental results are presented for Reynolds numbers between 100 and 40,000 and for the same Froude numbers as used in the numerical calculations. The numerical model with a Reynolds number of 100 compared best with the large-scale laboratory experiments, although there were substantial differences near the hill surface and in the wake of the hill.

35636 **(PB—87-167102/XAB) Modeling non-precipitating cumulus clouds as flow-through-reactor transformer and venting transporter of mixed-layer pollutants.** Ching, J.K.S. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Mar 1987. 14p. (EPA—600/D-87/074). NTIS, PC A02/MF A01.

A simple diagnostic model of cumulus convective clouds is developed and used in a sensitivity study to examine the extent to which the rate of change of mixed and cloud layer pollutant concentration is influenced by vertical transport and chemical transformation processes occurring as a result of cumulus clouds. The aqueous-phase-chemical transformation process is parameterized and modeled as a flow-through batch reactor. The net vertical exchange between the mixed and cloud layers by cumulus-cloud elements that protrude above the dry convective mixed layer is modeled as the product of a venting velocity and the difference in pollutant concentration between the mixed and cloud layer. The two-layer model yields an analytic expression involving key parameters such as areal extent of cloud cover, dry deposition rates, thickness in mixed and cloud layers, and the initial concentration difference between the mixed and cloud layers. The model solution was programmed using LOTUS 123.

35637 **(PB—87-167771/XAB) Field-audit results with organic gas standards on volatile organic ambient air samplers equipped with Tenax GC (gas chromatography).** Crist, H.L.; Mitchell, W.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). 1986. 5p. (EPA—600/J-86/279). NTIS, PC A02/MF A01.

Pub. in Environmental Science Technology, Vol. 20, No. 12, 1260-1262(1986).

The results from two field audits of Tenax-equipped sampling systems measuring the volatile organic (VOC) concentrations in ambient air are reported. The audited samplers collected the VOC's on Tenax GC (a solid adsorbent) with the VOC's later thermally desorbed and then analyzed by gas chromatography/mass spectrometry/computer (GC/MS/COMP). Each audit standard, prepared and certified by the National Bureau of Standards (NBS), contained at least four of the following compounds at the low parts per billion (ppb) level in dry N_2: C_6H_6, $C_6H_5CH_3$, C_6H_5Br, $C_6H_5C_1$, CHC_{13}, CC_{14} and C_2C_{14}. The results of the two audits were consistent and highlight some of the errors associated with sampling for VOC using Tenax GC. The agreement between successive sampling runs (repeatability) shows that the audit system itself is a viable means to audit the performance of VOC sampling systems at field sites.

35638 **(PB—87-167896/XAB) Commissioning of a new mobile emissions laboratory at Warren Spring Laboratory (Scottish Branch).** Stewart, R.; Walker, D.S. (Warren Spring Lab., Stevenage (UK)). 1985. 21p. (LR—583(PA)-M). NTIS, PC PC E04/MF E04.

Continuous measurements of carbon monoxide, sulfur dioxide, nitrogen oxides (NOx) and total volatile hydrocarbon emissions were carried out on the exhaust from boiler numbers 3, 4 and 5 of the National Engineering Laboratory's boiler house. These tests were primarily used to commission and prove Warren Spring Laboratory's new mobile emission laboratory in preparation for future sampling at large combustion and industrial plants as part of the program of work for the Department of the Environment on emission factors.

35639 **(PB—87-167912/XAB) Interlaboratory comparison of precipitation analysis - April 1985.** Heyes, C.J. (Warren Spring Lab., Stevenage (UK)). 1985. 42p. (LR—580(AP)-M). NTIS, PC PC E05/MF E05.

Synthetic precipitation samples were distributed to laboratories likely to participate in the United Kingdom secondary-precipitation composition-monitoring network. Each laboratory analyzed the samples for the same constituents and in the same way as their routine samples. Although the results were comparable with earlier United Kingdom and European inter-comparisons, there was evidence of considerable systematic error for some species at certain laboratories. This will require further investigation before monitoring commences.

35640 **(PB—87-167938/XAB) United Kingdom precipitation composition monitoring networks.** Devenish, M. (Warren Spring Lab., Stevenage (UK)). 1985. 31p. (LR—584(AP)-M). NTIS, PC PC E05/MF E05.

Following recommendations of the United Kingdom Review Group on Acid Rain and at the request of the Department of the Environment, two monitoring networks were established by Warren Spring Laboratory to obtain precipitation composition data for the United Kingdom. The report sets out the siting criteria and selection procedures for the monitoring sites, and lists the locations of the sites and details of the participating organizations. Operating procedures for both the primary and secondary network sites are described, together with details of the analyses of the precipitation samples and other pollution measurements obtained at the sites. Examples of site description and analysis report forms are given.

35641 **(PB—87-168076/XAB) National Performance Audit Program -- ambient air audits of analytical proficiency - 1985.** Parr, B.F.; Lampe, R.L.; Pratt, G.; Dowler, O.L.; Mitchell, W.J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Jan 1987. 63p. (EPA—600/4-87/002). NTIS, PC A04/MF A01.

See also report for 1984, PB—86-169968.

The report presents the results of the U.S. Environmental Protection Agency's 1985 National Audit Program by pollutant and by analytical method. Semiannual audits were conducted for Pb, NO_3 and SO_4 (filter strips) and acid rain, and annual audits were conducted for SO_2 (bubbler), NO_2 (bubbler), CO, and high-volume flow rate. Continuous SO_2 monitors were audited throughout the year, such that no monitor was audited more than once. Approximately 30 laboratories participated in each semiannual acid rain audit. Twelve laboratories participated in the SO_2 bubbler audit, and 18 in the NO_2. Approximately 55 laboratories participated in each NO_3 and SO_4 audit and approximately 100 laboratories in each Pb audit. Three hundred and twenty-five CO monitors, 257 SO_2 monitors and 1336 high-volume flow samplers were also audited. The results for each 1985 audit are presented in tabular form for each concentration level. The overall performance for all participants for each audit conducted since the beginning of the program is also illustrated in a series of figures.

35642 **(PB—87-168159/XAB) Characterization of hazardous-waste incineration residuals.** Van Buren, D.; Poe, G.; Castaldini, C. (Acurex Corp., Mountain View, CA (USA)). Mar 1987. 161p. NTIS, PC A08/MF A01.

The purpose of the study was to provide data on the quantities and characteristics of solid and liquid discharges from hazardous-waste-incineration facilities. A total of 10 facilities were sampled comprising major incineration designs and flue-gas-treatment devices. All inlet and outlet liquid and solid streams were sampled and subjected to extensive analyses for organic and inorganic pollutant concentrations. Laboratory analyses for solid discharge streams also included leachate evaluations using standard EPA toxicity tests for metals and a draft TCLP toxicity procedure for volatile and semivolatile organics and metals. Monitored data on incinerator facility operation were then used to determine the discharge rates of detected pollutants.

35643 **(PB—87-168399/XAB) User's manual for the Human Exposure Model (HEM). Interim report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Jun 1986. 120p. (EPA—450/5-86/001). NTIS, PC A06/MF A01.

This document describes the Human Exposure Model, furnishes contact personnel to establish access to the UNIVAC System, and provides step-by-step instructions for operating both the SHED and SHEAR portions of the model. The manual also lists caveats that should be considered when using the HEM and criteria to distinguish situations that are appropriately modeled by each portion of HEM. The intended audience ranges from someone with limited knowledge of modeling to someone well acquainted with the UNIVAC.

35644 **(PB—87-168654/XAB) Lime and cement industry particulate emissions: source category report. volume 2. cement industry. Final report, June 1983-August 1986.** Kinsey, J.S. (Midwest Research Inst., Kansas City, MO (USA)). Feb 1987. 407p. NTIS, PC A18/MF A01.

See also Volume 1, PB—87-103628; Portions of this document are not fully legible.

This volume of the report gives results of the development of particulate-emission factors, based on cutoff size for inhalable particles for the cement industry. After a review of available information characterizing particulate emissions from cement plants, the data were summarized and rated in terms of reliability. Size-specific emission factors were developed from these data for the major processes used in the manufacture of cement. A detailed process description is presented, with emphasis on factors affecting the generation of emissions. A replacement for Section 8.6 (Portland Cement Manufacturing) of EPA report AP-42, A Compilation of Air Pollutant Emissions Factors, was prepared, containing the size-specific emission factors developed during this program.

35645 **(PB—87-168688/XAB) Compendium of methods for the determination of toxic organic compounds in ambient air.** Riggin, R.M. (Battelle Columbus Labs., OH (USA)). Apr 1984. 160p. NTIS, PC A08/MF A01.

See also report dated Sep 86, PB—87-168696.

This methods compendium is intended to provide regional, state, and local environmental regulatory agencies, as well as other interested parties, with specific guidance on the determination of selected toxic organic compounds in ambient air. The current Methods Compendium consists of five methods for determining a wide variety of volatile organic compounds. Additional methods and/or modifications of the current methods will be added to the compendium from time to time.

35646 **(PB—87-168746/XAB) Evaluation of the problems associated with application of low solvent coatings to wood furniture. Final report, April 1984-April 1986.** Uhrmacher, C. (Carltech Associates, Columbia, MD (USA)). Jan 1987. 145p. NTIS, PC A07/MF A01.

The report gives results of an evaluation of a low volatile organic compound (VOC) finishing system for the manufacture of wood furniture, and compares its performance in the manufacturing process to an equivalent conventional solvent-based system. (NOTE: The coatings manufacturing industry has advanced the state-of-the-art for producing low-VOC based finishes for wood furniture. The improved systems include waterborne, high solids, and catalyzed high solids coatings. These new coatings have the potential to overcome the earlier objections of the furniture industry to lower VOC emissions in this industry.) The production of furniture finished with a conventional solvent-based system and several days production of wood furniture finished with a low-VOC system were observed and evaluated. The reduction in VOC emissions was estimated from consumption data obtained during the observation period. The low-VOC finishing system successfully met the criteria established in the GSA contract.

35647 **(PB—87-168753/XAB) Joint EPA-EPRI (Environmental Protection Agency-Electric Power Research Institute) Cold Weather Plume Study (CWPS): overview of measurements and data base. Final report.** Gillani, N.V.; Bohm, V.L. (Washington Univ., St. Louis, MO (USA). Dept. of Mechanical Engineering). Mar 1987. 87p. NTIS, PC A05/MF A01.

The Cold Weather Plume Study (CWPS) was a field measurement program carried out in February 1981 under the joint sponsorship of the U.S. Environmental Protection Agency and the Electric Power Research Institute. Its objective was to generate a data base suitable for quantitative analysis of the mesoscale physical dynamics and SOx, NOx chemistry of the plume of the 1320-MW coal-fired Kincaid power plant near Springfield, Illinois. The data base was intended to complement similar measurements made by other EPA and EPRI studies in the same region during other seasons. Measurements included in-situ chemical measurements from two instrumented aircraft, remote-sensing lidar measurements and meteorological measurements from a surface station, two towers, and from vertical soundings. The report provides a brief overview of the measurement platforms, the measured parameters, and the daily experiments, and describes and documents the data base available on magnetic tapes and in hard copy form.

35648 **(PB—87-168779/XAB) Interim Data Base for State and Local Air Toxic Volatile Organic Chemical Measurements.** Hunt, W.F.; Faoro, R.B.; Freas, W. (Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards). Dec 1986. 174p. (EPA—450/4-86/012). NTIS, PC A08/MF A01.

The report presents and analyses the information stored in the U.S. Environmental Protection Agency's Interim Data Base for State and Local Air Toxic Volatile Organic Chemical Measurements. The Data Base contains information on volatile organic chemical (VOC) data obtained from ten participating agencies at 126 monitoring sites, measuring either VOCs or benzo(a)pyrene.

Air-quality summary statistics are presented for 51 pollutants. Statistical distributions of estimated annual means are presented for 12 VOC pollutants, measured in California, and 8 VOC pollutants, measured outside of California. Comparisons are made between California and nonCalifornia data. The VOC data are summarized by location, sampling method, analytical method, start and end-sampling dates, units of measurement, the number of observations, minimum detection limit, the mean and maximum concentrations and averaging time of the sample.

35649 **(PB—87-168787/XAB) User's guide for PAL 2.0: a Gaussian-plume algorithm for point, area, and line sources. Final report.** Petersen, W.B.; Rumsey, E.D. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Mar 1987. 98p. (EPA—600/8-87/009). NTIS, PC A05/MF A01.

Supersedes PB—83-117739.

PAL is an acronym for the Point, Area, and Line source algorithm. PAL is a method of estimating short-term dispersion using Gaussian-plume steady-state assumptions. The algorithm can be used for estimating concentrations of non-reactive pollutants at 99 receptors for averaging times of from 1 to 24 hours, and for a limited number of point, area, and line sources (99 of each type). Calculations are performed for each hour. The hourly meteorological data required are wind direction, wind speed, stability class, and mixing height. Single values of each of these four parameters are assumed representative for the area modeled. The Pasquill-Gifford or McElroy-Pooler dispersion curves are used to characterize dispersion. The PAL model can treat deposition of both gaseous and suspended particulate pollutants in the plume since gravitational settling and dry deposition of the particals are explicitly accounted for. In the limit when pollutant settling and deposition velocities are zero, they reduce to the usual Gaussian-plume diffusion algorithms.

35650 **(PB—87-168803/XAB) Stability of parts-per-billion hazardous organic cylinder gases and performance audit results of source test and ambient-air measurement systems. Status report 3.** Allen, J.M.; Sokol, C.K.; Jayanty, R.K.M.; Decker, C.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). Mar 1987. 195p. NTIS, PC A09/MF A01.

See also PB—86-144656.

An evaluation of 27 gaseous organic compounds at parts-per-billion (ppb) levels in compressed gas cylinders was conducted by the U.S. Environmental Protection Agency (EPA). The primary objectives of this on-going project are: (1) to evaluate the quality of measurements made by USEPA, state/local agencies or their contractors by using ppb gas cylinders for performance audits to assess the relative accuracy of source measurement systems during hazardous-waste trial-burn tests and ambient air-monitoring programs; (2) to verify the manufacturer's certified analysis of the multi-component gas mixtures; (3) to determine the stability of gas mixtures with time; and (4) to develop new audit materials as requested by EPA. The cylinders consist of 4 mixtures of 5, 6, 7 and 9 organic compounds each. These mixtures were blended by a commercial gas supplier in aluminum cylinders in a balance gas of nitrogen. To date, 95 performance audits have been initiated and 76 are complete. The results of these audits and description of the experimental procedures used for analyses and available stability data are presented in this Status Report No.3.

35651 **(PB—87-168837/XAB) Comparison of weekly and daily wet-deposition sampling results. Supplemental report, December 1986.** Topol, L.; Lev-on, M.; Pollack, A.; Permutt, T.J. (Environmental Monitoring and Services, Inc., Camarillo, CA (USA)). Dec 1986. 125p. NTIS, PC A06/MF A01.

A collocated sampling study was conducted at three Utility Acid Precipitation Study Program sites (Uvalda, GA; Lancaster, KS; Underhill, VT). Each site was equipped with four identical precipitation samplers, two collecting daily samples and the other two collecting weekly samples. Except for the sampling schedule, all other procedures (e.g., sample transfer, storage, analysis) were the same. This study determined the effect of sampling frequency on: collection efficiency, the precision and chemical composition of the sample, the assessment of deposition amount, and the time required to detect trends in concentration and deposition.

35652 **(PB—87-169041/XAB) Respiratory symptoms in wool textile workers. Final report.** Love, R.G.; Smith, T.; Jones, C.O.; Gurr, D.; Soutar, C.A. (Institute of Occupational Medicine, Edinburgh (UK)). 1986. 138p. (IOM-TM—86/4). NTIS, PC PC E07/MF E07.

This epidemiological study was intended to investigate exposures to inspirable wool dust in selected wool textile mills, the patterns of respiratory symptoms reported by workers in the industry, and the relationships of symptoms to exposure to dust. Fifteen mills in West Yorkshire representing all stages of the woollen and worsted process, and production of carpet yarns, were included in the study, their size ranging from four to nearly four hundred employees.

35653 **(PB—87-169405/XAB) Assessment of particle and heavy-metal concentrations in the atmosphere around A. Cohen and Company at Woolwich.** Davis, B.J.; Clayton, P. (Warren Spring Lab., Stevenage (UK)). 1985. 25p. (LR—563(PA)-M). NTIS, PC PC E03/MF E03.

Warren Spring Laboratory (WSL) was commissioned by the Industrial Air Pollution Inspectorate of the Health and Safety Executive to conduct a series of investigations in the vicinity of registered non-ferrous metal works. The objective of such surveys is to assess the possible contribution of emissions, with emphasis on low-level fugitive emissions, to their concentrations in the ambient atmosphere using the Directional M-type Sampler developed by WSL. This report describes a survey carried out around A. Cohen and Company at Woolwich, London during the period October 1985 to January 1986.

35654 **(PB—87-169413/XAB) Assessment of particle and heavy-metal concentrations in the atmosphere around Fry's Metals at Merton in south London.** Davis, B.J.; Clayton, P. (Warren Spring Lab., Stevenage (UK)). 1985. 27p. (LR—565(PA)-M). NTIS, PC PC E05/MF E05.

Concentration of heavy metals in the ambient atmosphere have been measured during a three month period at two sites in the vicinity of Fry's Metals. The measurements were made using the Warren Spring Laboratory directional M-type sampler, which provided weekly samples taken both continuously and for periods when the wind was blowing from the direction of the works. Although the directional samples showed higher lead concentrations than corresponding ambient concentrations at the two sampling sites, the CD/CT ratios were less than 2 and it is concluded that the works contribution to ambient lead concentrations over the survey period was not significant.

35655 **(PB—87-169447/XAB) Measurements of nitrogen dioxide at rural sites using passive diffusion samplers.** Goldsmith, A. (Warren Spring Lab., Stevenage (UK)). 1985. 26p. (LR—582(AP)-M). NTIS, PC PC E05/MF E05.

Passive diffusional samplers were used to measure two to four week average concentrations of nitrogen dioxide at rural sites in the United Kingdom. The results of the first year of measurement, April 1985-March 1986, show distinct differences between the site in Northern Ireland and others in South-East England. In Northern Ireland the annual mean was 1.0 micrograms N /cu m (2 ppb) and the four-week average concentrations did not exceed 3 micrograms N /cu m. These show no obvious seasonal variation. At the other two sites the annual means were similar to 7 micrograms N /cu m, with a pronounced maximum in winter and minimum in summer. These values are lower than those recorded at CEGB Midlands sites though the seasonal variation is very similar. Mean concentrations of nitrogen species in rain and particles are also given for the same 12-month period. The concentrations found at these sites have been compared with modelled values.

35656 **(PB—87-169553/XAB) Bioassay-directed chemical analysis in environmental research.** Schuetzle, D.; Lewtas, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 11p. (EPA—600/J-86/220). NTIS, PC A02/MF A01.

Pub. in Analytical Chemistry 1986, Vol. 58, No. 1060A, 11.

The use of short-term bioassay tests in conjunction with analytical measurements, constitute a powerful tool for identifying important environmental contaminants. The authors have coined the terminology bioassay directed chemical analysis to best describe this marriage of analytical chemistry and biology. The objective of this methodology is to identify key compounds in various types of air-pollutant samples. Once that task is completed, studies on metabolism, sources, environmental exposure and atmospheric chemistry can be undertaken. The principles and methodologies for bioassay directed chemical analysis are presented and illustrated in this paper. Most of this work has been directed toward the characterization of ambient air and diesel particulates, which are used as examples in this report to illustrate the analytical logic used for identifying the bio-active components of complex mixtures.

35657 **(PB—87-169637/XAB) Evaluation of silica-gel cartridges coated in situ with acidified 2,4-dinitrophenylhydrazine for sampling aldehydes and ketones in air.** Tejada, S.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 21p. (EPA—600/J-86/215). NTIS, PC A02/MF A01.

Pub. in International Jnl. of Environmental Analytical Chemistry, Vol. 26, 167-185(1986).

A procedure for coating in-situ silica in commercially available prepacked cartridges with 2,4-dinitrophenylhydrazine (DNPH) acidified with hydrochloric acid is described. The coated cartridge was compared with a validated DNPH impinger method for sampling organic carbonyl compounds (aldehydes and ketones) in diluted automotive exhaust emissions and in ambient air for subsequent analysis of the DNPH derivatives by high performance liquid chromatography. Qualitative and quantitative results show that the two sampling devices are equivalent. An unknown degradation product of acrolein has been tentatively identified as x-acrolein. The disappearance of acrolein in the analytical sample matrix correlated quantitatively almost on a mole-for-mole basis with the growth of x-acrolein. The sum of the concentration of acrolein and x-acrolein appears to be invariant with time. This sum could possibly be used as a more-accurate value of the concentration of acrolein in the integratated sample.

35658 **(PB—87-169769/XAB) Indoor air quality: radon and formaldehyde. Report on a WHO (World Health Organization) meeting held at Dubrovnik (Yugoslovia), August 26-30, 1985. Environmental Health Series.** (World Health Organization, Copenhagen (Denmark). Regional Office for Europe). 1986. 52p. (EH—13). NTIS, PC PC E04/MF E01.

The report is of a working group held in 1985. The group reviewed radon and formaldehyde in relation to the ongoing indoor air-quality program of the Regional Office and also as part of the Air Quality Guidelines being developed for Europe. The report covers radon's sources, observed levels, conversion factors, routes of exposure, kinetics and dose considerations, health effects, evaluation of human health hazards, strategies of identification and control and conclusions and recommendations. For formaldehyde it covers sources, occurrence in air, routes of exposure, kinetics and metabolism, health effects, organoleptic properties, evaluation of human health hazard, and conclusions and recommendations.

35659 **(PB—87-170411/XAB) Measurement of light absorption extinction in Denver.** Lewis, C.W.; Dzubay, T.G. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 14p. (EPA—600/J-86/224). NTIS, PC A02/MF A01.

Pub. in Aerosol Science and Technology 5, 325-336(Sep 1986).

Simultaneous measurements of bext (teleradiometer), b(sup sp) (integrating nephelometer) and b(sup ag) (NO_2 monitor) were used to obtain particle absorption-extinction coefficients b(sup sp) for the Denver atmosphere during January 1982. The average of the ratio bap/b(sup sp) was measured to be 0.185 + or - 0.015 at 530 nm, which is 2-3 times smaller than previous measurements. Supplementary data included b(sup ap) measurements by the integrating-plate method, which yielded values systematically higher by about 35%, and elemental carbon (black soot) aerosol concentration, from which a value of 8.0 + or - 0.6 m sq/g-1 was obtained for the mass-specific absorption coefficient of elemental carbon.

35660 **(PB—87-170478/XAB) Application of cluster analysis to aerometric data (journal version).** Crutcher, H.L.; Rhodes, R.C.; Graves, M.E.; Fairbairn, B.; Nelson, A.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). 1986. 9p. (EPA—600/J-86/251). NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 36, No. 10, 1116-1122(Oct 1986); See also Volume 1, PB—82-226432.

The NORMIX data-analysis program, which incorporates cluster-analysis and multivariate statistical-analysis routines, was modified and revised for use in a UNIVAC 1110 computer. The revised program was tested on three sample data sets and produced results in agreement with those from the original program. The NORMIX program was then used to evaluate and analyze eight sets of aerometric data from various sources. Comparison of the performance of NORMIX with two other cluster analysis algorithms, MIKCA and SAS CLUSTER, revealed that all three programs produce similar results in terms of hierarchical clustering, but NORMIX produces considerably more statistical evaluation and information to the user. Thus NORMIX is recommended as the most useful cluster analysis program of these three.

35661 **(PB—87-171179/XAB) Procedures for estimating probability of nonattainment of a PM(10) NAAQS using total suspended particulate or PM(10) data.** Pace, T.G.; Meyer, E.L.; Frank, N.H.; Sleva, S.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Dec 1986. 64p. (EPA—450/4-86/017). NTIS, PC A04/MF A01.

The proposed primary National Ambient Air Quality Standards (NAAQS) for particulate matter (PM) specify ambient concentrations for particles smaller than 10 micrometers aerodynamic diameter (PM(10)). The document describes a methodology for using available PM(10) measurements in conjunction with TSP data to estimate whether or not the annual and/or 24-hour NAAQS for PM(10) are likely to be violated (probability of nonattainment). The probability of nonattainment is one of the criteria used to specify action States are to take in developing PM(10) monitoring requirements and State Implementation Plans (SIP's). The document also addresses appropriate methods for determining the spatial extent of the nonattainment situations.

35662 **(PB—87-171195/XAB) Review of control strategies for ozone and their effects on other environmental issues.** Meyer, E.L. (Environmental Protection Agency, Research Triangle Park, NC (USA). Monitoring and Data Analysis Div.). Nov 1986. 117p. (EPA—450/4-85/011). NTIS, PC A06/MF A01.

The review summarizes theoretical, experimental, field and modeling data related to effects of reducing volatile organic compounds (VOC), oxides of nitrogen (NOx) or both for meeting the ambient air-quality standard for ozone (O_3). Implications are reviewed for several environmental concerns. These include O_3 levels within and immediately downwind of major sources of precursors (i.e., cities), O_3 concentrations in rural/remote areas, ambient levels of nitrogen dioxide (NO_2), acidic species formation, and visibility attenuation.

35663 **(PB—87-171211/XAB) Effects of oxides of nitrogen on California air quality. Final report.** (California State Air Resources Board, Sacramento (USA). Technical Support Div.). Mar 1986. 304p. (ARB/TS—85-01). NTIS, PC A14/MF A01.

The report was written because of California Air Resources Board concerns about the multiple effects of oxides of nitrogen (NOx) emissions on California air quality. The deleterious effects are expected to increase because NOx emissions are expected to increase in 1990's. The report discusses six major products of nitrogen oxide (NOx) emissions: nitrogen dioxide, ozone, particulate nitrates, acid deposition, visibility impairment, other nitrogen compounds. For each product, the report describes health and welfare effects, atmospheric chemistry by which NOx emissions are transformed into various air pollutants, relevant ambient air quality

standards, ambient concentrations measured in California, and status in attaining ambient air standards. Because ozone is California's most severe air pollution problem, the report discusses in depth the relationship of NOx and ozone. In most areas of California, ozone strategies have reduced hydrocarbon emissions while maintaining NOx emissions. Evidence is increasing that reduction of NOx emissions also reduces ozone.

35664 **(PB—87-171229/XAB) Characterization of reactants, mechanisms, and species in South Coast Air Basin cloudwater. Final report.** Richards, L.W.; Anderson, J.A.; Alexander, N.L.; Blumenthal, D.L.; Knuth, W.R. (Sonoma Technology, Inc., Santa Rosa, CA (USA)). Jan 1987. 127p. (STI—94120-606-12FR). NTIS, PC A07/MF A01.

Sonoma Technology, Inc. (STI) conducted a study in 1985 for the California Air Resources Board in which an aircraft was used to collect cloud water, aerosol, and gas samples and to make other air-quality and meteorological measurements in stratus clouds in the Los Angeles Basin. The study continued the research on Los Angeles Basin stratus begun in 1981. The ambient concentrations of most non-volatile dissolved species in the cloud water usually decreased with time, showing that removal processes were important. Increases with time in lead and ammonia concentrations in the cloud water showed that vertical mixing was important. There was a slight tendency for nitrate concentrations to increase with time, but sulfate concentrations were relatively constant because of the very small sulfur concentrations in the clouds. The settling of droplets out of stratus clouds through air below the clouds containing ammonia and the evaporation of these relatively large droplets is suggested as a significant mechanism for the formation of large, nitrate-containing aerosol particles below the clouds.

35665 **(PB—87-171674/XAB) Guideline for surface-coating calculations.** (PEI Associates, Inc., Cincinnati, OH (USA)). Jul 1986. 85p. NTIS, PC A05/MF A01.

See also PB—85-159044.

The calculation of volatile organic compound emissions from surface coating operations to determine compliance is often a complicated task. In an attempt to minimize the confusion, EPA (OAQPS) has periodically issued guidance in the area, generally in the form of memoranda to the EPA Regional Offices. A Guideline for Surface Coating Calculations' takes the above guidance process one step further for surface-coating operations. Guidance is provided on how to compute existing and allowed emissions based on the above document as well as previously issued Control Technique Guidelines for the individual categories. Example calculations are included for basic emission problems, compliance determinations, equivalency determinations, application of transfer efficiency, and calculations involving complex multiproduct plants. The appropriate data sheets, a list of various equations and notations, and graphs and tables useful in making the above calculations are also included.

35666 **(PB—87-172060/XAB) Air-pollution injury on Pinus strobus in Cuyahoga National Recreation Area - 1985 survey results. Final report.** Sanchini, P.J. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Oct 1986. 84p. (HRI—94). NTIS, PC A05/MF A01.

Visible symptoms of ozone injury were observed on 97% of the Eastern white pine trees (Pinus strobus) sampled in 1985 from permanent plots at Cuyahoga National Recreation Area. Average injury was low and affected about 2.6% of the needle surface. None of the trees sampled had more than 10% injury. Chlorotic mottle was the most common ozone symptom encountered, followed by fleck injury and tipburn. Symptoms of other injury types were observed in 10% of the needle surfaces sampled. No significant variation among plots was observed in any of the injury symptoms. Total ozone injuries observed at Cuyahoga did not differ significantly from those observed in similar samples at other National Parks.

35667 **(PB—87-172078/XAB) Biomonitoring plots at the ozone monitoring stations at Great Smoky Mountains National Park - 1985 survey results. Final report.** Sanchini, P.J.; Stein, S.J. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Oct 1986. 48p. (HRI—93). NTIS, PC A03/MF A01.

High ambient-ozone levels recorded in Great Smoky Mountains National Park and the continued development in the valleys north and east of the Park have prompted concern about air-quality-related values in the Park. The goal of this research was to establish biomonitoring plots near four ozone monitoring stations in Great Smoky Mountains National Park. A total of seven plots was established, using four tree species known to be sensitive to air pollution. Foliar injury was evaluated on 115 trees in August and September 1985. No symptoms of ozone injury were observed. The report provides a detailed summary of the data collected in 1985, descriptions of the procedures used in evaluating trees, and directions to the study sites.

35668 **(PB—87-172110/XAB) Air-pollution injury on Pinus strobus in Great Smoky Mountains National Park - 1985 survey results. Final report.** Sanchini, P.J. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Oct 1986. 132p. (HRI—95). NTIS, PC A07/MF A01.

Visible symptoms of ozone injury were observed on 90% of the Eastern white pine trees (Pinus strobus) sampled in 1985 from permanent plots at Great Smoky Mountains National Park. Average injury was low and affected about 4% of the needle surface. Twenty-five percent of the trees sampled had more than 5% injury to needles. Only 6% of the trees sampled had more than 10% injury. Fleck injury was the most common ozone symptom encountered, followed by tipburn and chlorotic mottle. Total ozone injuries observed were lower than those observed in similar samples at Acadia National Park; however, trees at Great Smoky Mountains National Park had notably higher injury from biotic and abiotic causes.

35669 **(PB—87-172128/XAB) Air-pollution injury on Pinus strobus in Indiana Dunes National Lakeshore - 1985 survey results. Final report.** Sanchini, P.J. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Oct 1986. 92p. (HRI—97). NTIS, PC A05/MF A01.

Visible symptoms of ozone injury were observed on 100% of the Eastern white pine trees (Pinus strobus) sampled in 1985 from permanent pine plots at Indiana Dunes National Lakeshore. Average injury was low and affected about 5% of the needle surface. Only 6% of the trees sampled had more than 10% injury. Fleck injury was the most common ozone symptom encountered, followed by tipburn and chlorotic mottle. Significant variation among plots existed in total ozone injury, chlorotic mottle, tipburn, and needle length. Symptoms of other injury types were observed on 9% of the needle surfaces of sampled trees.

35670 **(PB—87-172136/XAB) Air pollution injury on Pinus Strobus in Acadia National Park - 1985 survey results. Final report.** Sanchini, P.J. (Butler Univ., Indianapolis, IN (USA). Holcomb Research Inst.). Oct 1986. 122p. (HRI—96). NTIS, PC A06/MF A01.

Visible symptoms of ozone injury were observed on 90% of the Eastern white pine trees (Pinus strobus) sampled in 1985 from permanent pine plots at Acadia National Park. Average injury was low and affected about 4% of the needle surface. Only 10% of the trees sampled had more than 10% injury. Chlorotic mottle was the most common symptom encountered, followed by fleck injury and tipburn. Total ozone injuries were significantly higher than those observed in a similar sample from Great Smoky Mountains National Park; however, the trees at Acadia had notably lower injuries from other biotic and abiotic causes.

35671 **(PB—87-173068/XAB) Comparison of air-quality model estimates with measured SO_2 concentrations near March Point, Washington. Final report.** Winges, K.D. (TRC Environmental Consultants, Inc., Mill Creek, WA (USA)). Dec 1986. 102p. (REPT—3710-Q81). NTIS, PC A06/MF A01.

The report documents an air-quality modeling study of sulfur dioxide concentrations near March Point, Washington. The current study evaluated the measured data from these air-quality monitors with predictions using the SHORTZ and ISCST air-quality models. A series of 20 different test periods were used in the model evaluations. Neither model preformed well in a comparison

of measured and predicted values when the data are paired in space and time. However, model prediction improved for both models when comparison was performed with the data paired in time, but not in space. The main conclusions were that air monitoring is not necessary, given the low level of impacts, and that neither model offers significant advantages unless terrain heights are higher than the stack heights, in which case the SHORTZ Model is preferred.

35672 **(PB—87-173852/XAB) Information profiles on potential occupational hazards: sulfur tetrafluoride. Second draft.** (Syracuse Research Corp., NY (USA). Center for Chemical Hazard Assessment). Apr 1981. 15p. (SRC-TR—81-549). NTIS, PC A02/MF A01.

Information on the potential occupational hazards from sulfur tetrafluoride was reviewed. Topics discussed included chemical and physical properties, production, use, manufacturers and distributors, manufacturing processes, occupational exposures, and biological effects. A national survey indicated that approximately 1,200 workers are potentially exposed to sulfur tetrafluoride. Studies have indicated that sulfur tetrafluoride is highly toxic, irritating, and corrosive to skin, eyes and the respiratory system. Studies in rats showed that sulfur tetrafluoride at 19 parts per million was lethal to one of two rats exposed for 4 hours. A subchronic study showed that rats exposed to 4 parts per million for 4 hours/day for 10 days developed labored breathing, weakness and nasal discharge; after a 14 day recovery period, no significant pathological changes were seen on autopsy. No information was found on carcinogenicity, mutagenicity, or teratogenicity.

35673 **(PB—87-175022/XAB) Airborne Lidar tracking of fluorescent tracers for atmospheric transport and diffusion studies.** Uthe, E.E.; Viezee, W.; Morley, B.M.; Ching, J.K.S. (SRI International, Menlo Park, CA (USA)). 1985. 11p. NTIS, PC A02/MF A01.

Pub. in Bulletin of American Meteorological Society, Vol. 66, No. 10, 1255-1262(Oct 1985).

Development and validation of transport models for the study of regional acid deposition require improved observations of pollutant transport and dispersion processes. Current methods for tracking air-parcel is limited to constant-density surfaces using tetroons or by gaseous tracers requiring the use of in-situ aircraft. The feasibility of using an airborne lidar system to observe atmospheric transport and dispersion of fluorescent-dye particle (FDP) tracers is promising and was demonstrated for various meteorological conditions and FDP release scenarios in the general area of the Cross-Appalachian Tracer Experiment (CAPTEX) during October 1983. The paper presents some of the results obtained on six case studies, each of which illustrates a unique application of the technique.

35674 **(PB—87-176640/XAB) Small-scale pilot evaluation of calcium- and sodium-based sorbents for dry SO_2 removal. Report for January-December 1986.** Jorgensen, C.; Chang, J.C.S.; Brna, T.G.; Sedman, C.B. (Acurex Corp., Research Triangle Park, NC (USA)). Mar 1987. 32p. NTIS, PC A03/MF A01.

The paper discusses a 100 cu m/h pilot facility (consisting of a spray dryer, a sorbent injection system, a duct section, and a pulse-jet baghouse or cyclone separator) used for testing the reaction at low temperature between various calcium- and sodium-based sorbents and SO_2 in the concentration range of 1000-2500 ppm. The sorbents tested were based on earlier-reported sand-bed reactor (0.3 cu m/h) tests. The performance of these sorbents is compared in terms of SO_2 removal and stoichiometry with that obtained using conventional slaked lime in spray drying or dry injection under similar conditions.

35675 **(PB—87-176707/XAB) Relationships between direction of wind flow and ozone inflow concentrations at rural locations outside of St. Louis, Missouri.** Altshuller, A.P. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). 1986. 13p. (EPA—600/J-86/309). NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 20, No. 11, 2175-2184(1986).

The relationships between the monthly averages of daily 1200-1500 HO_3 inflow concentrations and the wind flow direction are evaluated using measurements at rural locations outside of St. Louis, Missouri. Although there may be a stratospheric component to these ground level rural O_3 concentrations, most of the O_3 measured can be associated with photochemical O_3 formation in the free troposhere and in the boundary layer. Most of the gradient in rural O_3 concentrations from west to east of St. Louis is attributed to higher anthropogenic emissions of O_3 precursors to the east rather than to differences in meteorological conditions from west to east.

35676 **(PB—87-177077/XAB) Fluxes of gases and particles above a deciduous forest in wintertime.** Wesely, M.L.; Cook, D.R.; Hart, R.L. (Argonne National Lab., IL (USA). Environmental Research Div.). 1983. 21p. NTIS, PC A02/MF A01.

Pub. in Boundary-Layer Meteorology, Vol. 27, 237-255(Nov 1983).

Eddy-correlation measurements of the vertical fluxes of ozone, carbon dioxide, fine particles with diameter near 0.1 micrometers, and particulate sulfur, as well as of momentum, heat, and water vapor, were taken above a tall leafless deciduous forest in wintertime. During the experimental period of one week, ozone-deposition velocities vary from about 0.1 cm s(-1) at night to more than 0.4 cm s(-1) during the daytime, with the largest variations associated primarily with changes in solar irradiation. Carbon dioxide fluxes are directed upward, due to respiration in the leaf litter and soil beneath the canopy, and exhibit a strong dependence on air temperature. The fluxes are approximately zero at air temperatures less than 5 C and approach 0.8 mg m(-2) s(-1) when temperatures exceed 15 C during the daytime. Fine-particle deposition rates are large at times, with deposition velocities near 0.8 cm s(-1) when turbulence levels are high, but fluxes directed upward are measured above the canopy when the surface beneath is covered with snow. Deposition velocities for particulate sulfur are highly variable and average to a value small in magnitude as compared to similar measurements taken previously over a pine forest in summer.

35677 **(PB—87-177085/XAB) Comparison of audit techniques and performance audit results for EPA Method 25 for volatile organic compounds.** Jayanty, R.K.M.; Howe, G.B.; von Lehmden, D.J.; Fuerst, R.G.; Logan, T.J. (Research Triangle Inst., Research Triangle Park, NC (USA)). Apr 1987. 15p. NTIS, PC A02/MF A01.

Organic audit materials have been developed by U.S. Environmental Protection Agency to evaluate quality of measurements made by federal, state, and local agencies or their contractors during compliance source tests. Among audit materials are materials for auditing EPA Method 25, a method for measuring source emissions of volatile organic compounds. Two types of audit materials for Method 25 have been developed and validated by inter- and intra-laboratory studies. The first type makes use of commercially available gas cylinders containing known concentrations of selected volatile organics in an inert balance gas. The second type involves use of a stainless steel cartridge containing a solid sorbent (Tenax) spiked with known quantities of selected organic compounds to generate organic vapors quantitatively using thermal desorption. Results indicate both types of audit materials are stable and useful in conducting EPA Method 25 audits.

35678 **(PB—87-178802/XAB) Comparison of teleradiometric and sensitometric techniques for visibility measurements.** Seigneur, C.; Hogo, H.; Johnson, C.D. (Systems Applications, Inc., San Rafael, CA (USA)). 1984. 9p. NTIS, PC A02/MF A01.

Pub. in Atmospheric Environment, Vol. 18, No. 1, 227-233(Jan 1984).

Visibility measurements of power plant and smelter plumes were conducted as part of the 1981 VISTTA field programs by means of sensitometry of color photographic slides and teleradiometry. The results obtained with these two techniques at three wavelengths (450, 550, and 630 nm) were compared and showed good agreement for plume/sky-radiance ratios, with correlation coefficients on the order of 0.9 and average absolute differences of 2 to 4%. The uncertainty in the plume/sky radiance ratio is about 4% for sensitometry. Although this value is slightly higher than the uncertainty of 2% previously reported for teleradiometry (Bergstrom et al., 1982), sensitometry offers the advantage of an instanta-

neous measurement. In contrast, a teleradiometer scan takes on the order of 15 minutes, and plume visual effects can show large variations in this short time period.

35679 **(PB—87-178836/XAB) Residential population exposure to ambient benzene in California. Final report.** Allen, P.D. (California State Air Resources Board, Sacramento (USA). Technical Support Div.). Feb 1987. 32p. (ARB/TS—87-01). NTIS, PC A03/MF A01.

Annual average exposure to ambient benzene concentrations is estimated for the residential population of California. No consideration is given to indoor or any non-residential benzene exposure. Annual average benzene for 1984 varied from a low of 0.8 ppb to a maximum of about 7.5 ppb. The population weighted annual concentration was 3.3 ppb for the entire State. A benzene emission inventory was also developed for California resolved to the county level. Motor vehicles accounted for almost 80% of the residential exposure to benzene in the State. Carbon monoxide ratios measured in ambient air were compared to ratios predicted using the emission inventory. The ratios agreed to within 25%.

35680 **(PB—87-179842/XAB) Analysis of the Southern California Air Quality Study (SCAWS) measurement plan. Final report.** Seinfeld, J.H. (California Inst. of Tech., Pasadena (USA)). 1986. 185p. NTIS, PC A09/MF A01.

The major goal of the planned Southern California Air Quality Study (SCAQS) is to develop an air quality and meteorological data base for the South Coast Air Basin (SOCAB) that can be used to test, evaluate, and improve air-quality simulation models for oxidants, NO_2, PM-10, fine particles, visibility, toxic substances, and acidic species. To aid in planning the measurement program, a Model Working Group was established. The report contains the analyses of the SCAQS measurement plan by the Model Working Group.

35681 **(PB—87-179982/XAB) Personal exposures, indoor and outdoor air concentrations, and exhaled breath concentrations of selected volatile organic compounds measured for 600 residents of New Jersey, North Dakota, North Carolina and California.** Wallace, L.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). 1986. 24p. (EPA—600/J-86/340). NTIS, PC A02/MF A01.

Pub. in Toxicological and Environmental Chemistry, Vol. 12, 215-236(1986).

EPA's TEAM Study measured exposures to 20 volatile organic compounds in personal air, outdoor air, drinking water, and breath of 600 residents of New Jersey, North Carolina, North Dakota, and California. Participants carried a personal monitor to collect two 12-hour air samples and gave a breath sample at the end of the day. Two consecutive 12-hour outdoor air samples were also collected on identical Tenax cartridges in the backyards of some of the participants. About 7500 samples were collected, of which 2000 were quality-control samples. Eleven compounds were often present in air. Personal exposures were consistently higher than outdoor concentrations. Indoor sources appeared responsible for much of the difference. Breath concentrations also usually exceeded outdoor concentrations, and correlated more strongly with personal exposures than with outdoor concentrations. Some activities (smoking, visiting dry cleaners or service stations) and occupations (chemical, paint, and plastics plants) were associated with significantly elevated exposures and breath levels for certain toxic chemicals. Residence near major point sources did not affect exposure.

35682 **(PB—87-180022/XAB) Compensating for wall effects in IAQ (indoor air quality) chamber tests by mathematical modeling. Report for June 1986-February 1987.** Dunn, J.E.; Tichenor, B.A. (Arkansas Univ., Fayetteville (USA)). Apr 1987. 19p. NTIS, PC A02/MF A01.

The paper presents mechanistic mathematical models that account for two phenomena: interior surfaces of a state-of-the-art emissions test chamber acting as a transient sink for organic emissions; and the effect of increasing chamber concentration on the emission rate of the source. As a consequence of this mathematical development, a source emission rate as a function of time and a steady-state emission rate factor are given precise definitions. Applications involve modeling 1,4 dichlorobenzene emission from moth crystals, and mixed emissions from latex caulk.

35683 **(PB—87-180030/XAB) Automated data acquisition and control system bolsters EPA's (Environmental Protection Agency's) air pollution research.** Ziminski, P.K.; Holman, S.R. (Northrop Services, Inc., Corvallis, OR (USA)). 1987. 7p. NTIS, PC A02/MF A01.

Pub. in HP Design and Manufacturing, 12-15(Mar 1987).

The introduction of advanced microcomputer technology to the research laboratory has enhanced the way scientists design and perform experiments. The Environmental Research Laboratory of the U.S. Environmental Protection Agency in Corvallis, Oregon, is researching the effects of air pollutants on agricultural and native plant species. The laboratory is capable of performing studies directly related to ambient air quality due to this microcomputer technology.

35684 **(PB—87-180055/XAB) Establishment of an Eastern Visibility Fine-Particle Network.** Evans, E.G.; Fitz-Simons, T.; Lumpkin, T.A.; Barnard, W.F. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Apr 1987. 10p. (EPA—600/D-87/062). NTIS, PC A02/MF A01.

A comprehensive assessment of eastern regional haze is being undertaken by EPA's Environmental Monitoring Systems Laboratory. An Eastern Visibility Fine-Particle Network (EVFPN) is being set up to study the relationships between fine particles and visibility. A long-term data base will be established to aid in determining spatial and temporal variations in indicators of visibility degradation in the Eastern United States. A further refinement of the visibility/particulate components relationships, with emphasis given to the nonsulfate components such as carbon and nitrate, will be developed. The monitoring strategy used to obtain optical properties, aerosol characteristics, and the characteristics of a scene are discussed along with the general overview of the Eastern Visibility Fine-Particle Network.

35685 **(PB—87-180501/XAB) Photoacoustic detection of NO_2, H_2CO, and CH_3CHO. Final report.** Atkinson, G.H. (Arizona Univ., Tucson (USA)). 1986. 65p. NTIS, PC A04/MF A01.

Photoacoustic spectroscopy (PAS) was used to detect the atmospheric pollutants NO_2, H_2CO, and CH_3CHO over more than six orders of magnitude in concentration. Two different instrumental approaches were designed, constructed, and tested. Instrumentation based on cw laser excitation in the visible gave excellent results for NO_2, but was not usable for species absorbing in the ultraviolet. Instrumentations based on pulsed lasers and nonlinear optics operating in the ultraviolet gave excellent results for all three species. Flowing and stopped-flow sampling techniques were developed for use with PAS measurements to emulate the sampling conditions anticipated for field applications. Experimental measurements for these three species in mixtures of NO_2, H_2CO, and CH_3CHO are underway; the initial results, however, indicate that the detection limits reported here can be obtained in mixtures as well.

35686 **(PB—87-180550/XAB) Development and evaluation of a real-time pH and conductivity rain monitor. Final report for 1984-1986.** Paur, R.J. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Apr 1987. 141p. NTIS, PC A07/MF A01.

Acidic wet deposition (acid rain) is thought to be responsible for a variety of deleterious effects on ecosystems and on natural and man-made materials. Determining and quantitating these effects is complicated by the fact that rain is a low-ionic-strength solution of many different salts and organic compounds. The report describes the features and performance of a monitor that was designed to fractionate a rain event into samples corresponding to 0.3 mm of rain, determine the pH and conductivity of the sample within approximately one minute of collection, and store the remainder of the sample for more-detailed analysis.

35687 (PB—87-180568/XAB) **Heterogeneous-reaction-rate studies of SO_2, NO_2, and HNO_3 with aqueous droplets. Final report.** Gardner, J.A.; Sharfman, L.R.; Adewuyi, Y.; Davidovits, P. (Aerodyne Research, Inc., Billerica, MA (USA)). Nov 1986. 37p. (ARI-RR—531). NTIS, PC A03/MF A01.

Heterogeneous-reaction pathways involving water droplets in clouds and fogs are important mechanisms for chemical transformations of atmospheric trace gases. One of the basic parameters that determines the transfer rate of trace gases into droplets is the mass accommodation or sticking coefficient for trace gas molecules on aqueous-droplet surfaces. A laboratory method has been developed for directly determining sticking coefficients and was applied to SO_2, NO_2, HNO_3, and H_2O_2. The method combines a monodisperse droplet stream generated at a vibrating orifice with a low-pressure flow reactor.

35688 (RFP—3990, pp 1-8) **Resuspension of beryllium particles from machine shop coveralls and machining operations.** Langer, G. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

Airborne beryllium particles are generated from machining operations at Rocky Flats. This study contributes to the development of control strategies reducing worker exposure to beryllium. Industrial Hygiene personnel used a light scattering particle counter to monitor beryllium particle size and concentration at their point of generation on a machine. This report analyzes the particle data. Also, the authors studied the resuspension of beryllium particles deposited on coveralls as a source on inhalable beryllium. An air shower was tested for the removal of beryllium particles from shop coveralls. 10 references, 6 figures, 3 tables.

35689 (TVA/ONRED/AWR—87/15, pp 13-15) **Atmospheric deposition and nutrient cycling in high- and low-elevation coniferous forests in the southeast.** Lindberg, S.E.; Owens, J.G.; Schaefer, D.A.; Silsbee, D. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

As part of the Electric Power Research Institute's Integrated Forest Study, the authors are measuring atmospheric deposition at two southern Appalachian sites. The high-elevation (1800 m) site is a red spruce (Picea rubens) forest in the Great Smoky Mountains National Park. The low-elevation (300 m) site is a loblolly pine (Pinus taeda) forest, 90 km northwest of the park. Meteorological and chemical data are both collected continuously and on an event basis to compare the rates of wet and dry deposition of inorganic ions to indigenous coniferous forests. In addition, weak acid concentrations in rain, streamflow (SF), and throughfall (TF) are determined using Gran's plot titrations. Climatic data confirm the expected differences in atmospheric exposure conditions between sites; precipitation, windspeed, and cloud/fog immersion time increase with elevation by factors of 2 to 50. Cloud water at the high-elevation site is dominated by HNO_3 and H_2SO_4 and ranges in pH from 2.3 to 5.2. Fog at the low-elevation site is dominated by Ca^{2+} and NH_4^+ salts of SO_4^{2-} and ranges in pH from 3.9 to 5.8. Unlike cloud water, ground-level radiation fogs form under atmospherically stable nighttime conditions which lead to effective neutralization of scavenged acidity by basic constituents that have significant ground-level sources (e.g., NH_3 and $CaCO_3$).

35690 (TVA/ONRED/AWR—87/15, pp 19-20) **Integrated forest response program.** Cowling, E.B.; Bruck, R.I.; Saxena, K.; Robarge, W.P.; Cavalier, J.; Hendler, A.H. (State Univ. of Raleigh, NC). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

A program to characterize atmospheric chemical deposition to spruce-fir ecosystems was established during the spring of 1986. The airborne chemicals of interest in these dry and wet deposition events include: 1. Selected toxic or reactive gases including sulfur dioxide, nitrogen oxides, ozone, and hydrogen peroxide, and nitric acid and ammonia vapors, and other photochemical oxidants such as formaldehyde and peroxyacetyl nitrate. 2. Selected ionic materials in fine aerosols and coarse particles including the following: cations: calcium, magnesium, potassium, sodium, and ammonium; anions: sulfate, nitrate, phosphate, and chloride. 3. Selected water-soluble and water-insoluble ionic materials dissolved or suspended in cloud or fog water and precipitation including the following: cations: calcium, magnesium, potassium, sodium, and ammonium; anions: sulfate, nitrate, phosphate, and chloride. 4. pH and conductivity.

35691 (TVA/ONRED/AWR—87/15, pp 22-24) **Seasonal comparison of cloud chemistry and ozone data at Whitetop Mountain, Virginia.** Meagher, J.F.; Reisinger, L.M.; Bailey, E.M.; Garber, R.W.; Weatherford, F.P. (Tennessee Valley Authority, Muscle Shoals, AL). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Since October 1985, when the Whitetop Mountain, Virginia, research station became operational, TVA has continuously monitored a number of routine parameters and have intensively monitored key cloud water parameters on a quarterly basis (except during the winter) at this southern site. Some of the results from the first year of monitoring are summarized. Specifically, an analysis of cloud physics and chemistry and measurements and associated cloud-free ozone, hydrogen peroxide, and sulfur oxide data are described. An analysis of cloud frequency and associated meteorology indicates that clouds engulfed the summit site one-third of the time. A comparison of precipitation and cloud water acidity was made from data obtained during the spring and summer month-long intensives. On average, the acidity of the cloud water was twice that of the precipitation during the spring and over five times that of the precipitation during the summer. A diurnal comparison of gas phase hydrogen peroxide data and ozone was made for the period July 24 through August 10, 1986. A strong similarity exists in the diurnal patterns of these two oxidants. An early morning (0600 to 0800 EST) concentration minimum is followed by a steady rise to an early evening (1800 to 2100 EST) concentration maximum. An analysis of gas and liquid phase hydrogen peroxide, sulfur dioxide, and liquid phase and particulate sulfate was made for the period August 8 to 11, 1986. A time series analysis shows a gradual build-up in both gaseous and liquid phase hydrogen peroxide from gas phase values near 0.3 ppb on August 8 to values of 1.5 ppb on August 10. By the morning of August 11, gas phase concentrations were again around 0.3 ppb.

35692 (TVA/ONRED/AWR—87/15, pp 25-26) **Chemical interaction between cloud water and red spruce foliage.** Joslin, J.D.; Brewer, P.F. Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

TVA is studying pollutant deposition and forest response at the summit of Whitetop Mountain (1682 m or 5475 ft) in southwestern Virginia. To characterize total pollutant input to the mountain top spruce forest, meteorological variables and clouds, fog, precipitation, gases, and particulates are being characterized using a combination of continuous and quarterly intensive sampling. These data plus forest parameters will be used with models of cloud interception and dry deposition to estimate total pollutant deposition. Studies of forest response are focusing on the impacts of cloud interception and ozone exposure. Cloud water intercepted by foliage is being collected as throughfall beneath individual spruce seedlings and beneath the mature spruce forest canopy. Throughfall is collected at hourly intervals only during cloud events, and the chemistry of these samples is compared to that of cloud water samples collected concurrently on teflon string collectors. Differences in elemental concentrations may be attributed to the net effect of foliar uptake, foliar leaching, and dilution or concentration of ions due to prior wet and dry deposition or evaporation. Preliminary analyses of cloud events during spring and summer 1986 indicate that the acidity and ionic strength of cloud water are greater than

that of rain water and generally increase with decreasing liquid water content.

35693 (TVA/ONRED/AWR—87/15, pp 29-30) **Important parameters for deposition modeling.** Mueller, S.F. (Tennessee Valley Authority, Muscle Shoals, AL). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

The deposition of acidic substances in precipitation is easily measured, and is being monitored routinely at many sites across the US and Canada. However, the input of acidic material to forests through the direct dry deposition of particulates and gases, and through the interception of cloud water by forest canopy components, is not readily determinable. Efforts to determine acidic deposition by dry and cloud water mechanisms are, therefore, forced to rely on models. Models of dry deposition processes are usually based on the assumption that the deposition rate is proportional to the air concentration of the substance being deposited. The ratio of the deposition rate to air concentration has units of speed and is called a deposition velocity. Deposition velocity is a complex function of canopy type, canopy structure, the nature of the depositing gas or particulates, and meteorological conditions. Several cloud water deposition models have also been developed. Recently Lovett (1984) published the results of a comparison between deposition model calculations and observations of water throughfall in a forest canopy. The Lovett model is based on the electrical resistance analogy and is similar to the ATDL dry deposition velocity model.

35694 **Beyond acid rain.** Gaffney, J.S.; Streit, G.E.; Spall, W.D.; Hall, J.H. (Los Alamos National Lab., NM). *Environmental Science and Technology;* **21**: No. 6, 519-524(Jun 1987).

This paper discussed the effects of the interactions of soluble oxidants and organic toxins with sulfur dioxide and nitrogen dioxide. It suggested that these chemical reactions in the atmosphere produced a more potent acid rain which was harmful not only because it had a low pH but because it contained oxidants and organic toxins which were harmful to surface vegetation and the organisms found in surface waters. It was stressed that air pollution is a global problem and that is is necessary to develop a better fundamental understanding of how air pollution is causing damage to the streams and forests of the world. 50 references.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 34856, 34857, 35658, 35745

35695 (DOE/EV/10305—T1) **Environmental effects on ^{222}Rn fluence rate from reclaimed uranium mill tailings.** Morris, R.C. (Colorado State Univ., Fort Collins (USA). Dept. of Radiology and Radiation Biology). Spr 1987. Contract AC02-79EV10305. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010678.

The author measured ^{222}Rn fluence rate from 2 plots with uranium mill tailings buried beneath 30 cm of overburden and 30 cm of topsoil. An additional 30 cm of clay covered the tailings on 1 of the plots and each plot was subdivided into bare soil and vegetated subplots. The author also measured a control plot, identical to the plot without a clay cap but having no tailings. In addition to fluence rate, The author measured moisture in each of the plot layers, atmospheric pressure, air temperature and relative humidity during each sampling period. The author used linear correlation, two-way ANOVA and stepwise multiple regression to analyze the effects of the plot characteristics and the environmental variables on ^{222}Rn fluence rate. The mean fluence rate from the plot having both a clay cap and a vegetated surface was over 3 times that of the vegetated plot without a clay cap and 14 times that of the bare plot with a clay cap. The interaction effect may be due to the proliferation of roots in the moist clay and active transport of dissolved ^{222}Rn to the surface in water.

35696 (ISH—18) **Research studies and activities of the Division Radioactive Substances and the Environment.** Schwibach, J.; Schmier, H.; Haubelt, R.; Winkelmann, I.; Wirth, E. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Feb 1983. 77p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-10121.

The research studies and activities are carried out by the four sections: Natural and Artificial Radioactivity, Radiation Protection of the Population, Surveillance of Radioactive Emissions and Radioecology. The individual research projects and activities are reviewed in 48 separately described general outlines. The purpose, structure and current work level are each referred to in summarized form. The many facets of radiation protection today and the resulting tasks for the division are demonstrated.

35697 (ISH—33) **Activated carbon bed used for integrating measurements of ^{222}Rn concentration in air.** Pensko, J. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1983. 24p. NTIS, PC E07; Available from NTIS as TIB/B86-10117.

The application of activated charcoal beds for these measurements make it possible to estimate the average ^{222}Rn concentration in indoor air or in non-uranium mines in a simple way after about 3 days. The great advantage of this method is that the charcoal canisters are cheap, easy for preparation and handling. The same activated carbon bed can be used many times after simple heating procedure. The method is sensitive and accurate enough for environmental radon monitoring in many situations.

35698 (ISH—43) **Radon concentration and radiation exposure due to radon daughter products in non-uranium mines in the EC, and factors of influence. Final report.** Kompa, R.; Pensko, J.; Schmier, H. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jul 1984. 59p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-00426.

A number of nine mines representing a variety of underground structures and ventilation systems have been examined. The personnel underground differed in number from only a few to some hundred miners. The results measured for radium-226 are between 2 and 130 Bq/kg, for thorium-228 between 2 and 74 Bq/kg, and for potassium-40 between 30 and 950 Bq/kg. The fluctuations of radon-222 concentrations in a given mine are obviously correlated with the ventilation conditions.

35699 (PNL—6120) **Environmental monitoring at Hanford for 1986.** (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 225p. NTIS, PC A10. File Number DE87011613.

Environmental monitoring at the Hanford Site is conducted by the Battelle Memorial Institute, Pacific Northwest Division, as part of its contract to operate the Pacific Northwest Laboratory (PNL) for the US Department of Energy. The data collected provide a historical record of the levels of radionuclides and radiation attributable to natural causes, worldwide fallout, and Hanford operations. Data are also collected to monitor the status of chemical materials on the Site and in the Columbia River. This report represents a single, comprehensive source of environmental monitoring data collected during 1986 by PNL's Environmental monitoring Group in the offsite and onsite environments. Appendix A contains data and data summaries for results obtained during 1986 that include statistical estimates of variation. Information in Appendix A is intended for readers with a scientific interest or for those who wish to evaluate results in a manner not included here. 71 refs., 66 figs., 17 tabs.

35700 (RFP—3990, pp 8-13) **Ambient air quality in uranium production areas.** Langer, G. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

The purpose of this ambient air quality study was to measure the concentration and particle size of airborne uranium-328 particles in the depleted uranium production areas of Building 444 of the

Rocky Flats Plant. Operations in this building include reclamation of uranium-238 scrap by re-melting into ingots, and oxidation of uranium-238 chips in a chip roaster. Previous ambient air quality studies have monitored the operations of a roller mill, shears, and extrusion presses in Building 865. Data for all operations were reviewed in this study. The results were used to evaluate the health hazard of the dust in both buildings. 1 reference, 3 figures, 3 tables.

35701 (RFP—3990, pp 17-21) **Evaluation of PM-10 commercial inlets for new surveillance air sampler.** Langer, G. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

The inlet for the present Rock Flats Plant surveillance sampler does not meet the new but still tentative PM-10 (<10-μm particle mass) criterion for sampling the hazardous fraction of airborne dust. Since this criterion relates mainly to non-radioactive emissions, DOE and EPA are presently in the process of promulgating emission guidelines specifically for non-reactor DOE nuclear facilities. The authors present approach is to select a commercial inlet and modify its, if necessary, to meet the PM-10 criterion, keeping in mind that they may have to recover the dust collected in the inlet. There is no EPA-approved PM-10 inlet design; instead, EPA issued a performance specification. As a nuclear operation, Rocky Flats has to sample continuously to ensure no period remains unmonitored, instead of every sixth day, as set forth by EPA for non-nuclear installations. During this study period, the authors developed an inlet evaluation methodology to meet the above, anticipated EPA requirements. Also, they started testing two potential inlets. 6 references, 2 figures, 1 table.

35702 (RFP—3990, pp 21-33) **Study of laboratory contamination by airborne particles at Rocky Flats Plant.** Langer, G. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

The purpose of this study is to establish if the high values exhibited by analytical blank samples and high variability among the blank samples and high variability among the blank sample population are related to wind-borne dust entering laboratories via doors, cracks in walls and window frames. The Health, Safety and Environmental Laboratories at Rocky Flats encounter high analytical blanks and high blank variability that result in degraded analytical sensitivity. One possible cause that can be associated with those problems is environmental dust particles that become incorporated into blank samples and reagent solutions. Of particular concern are such trace elements as uranium and thorium that carry alpha activity. This study includes year-round measurements inside and outside the laboratories to define the amount of dust, the size distribution of the dust particles and the elemental chemical composition of the samples. In addition to these measurements, samples were taken du7ring windy periods to establish if the concentration of possible interfering elements increased. This data base should be related to the incidence of laboratory quality control problems. 1 reference, 5 figures, 5 tables.

35703 (RFP—3990, pp 42-47) **Nuclear track studies of individual plutonium-239 particles in gaseous effluents and in the environment.** Langer, G. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

The detection and size determination of individual plutonium particles are important in the control of plant effluent streams. Also, when dealing with plutonium particles in the environment, it is very important to know their size and location on a surface. CR-39 plastic foil has now made routine detection of alpha tracks possible. This technique has been applied to the following projects: 1. Calibration of CR-39 foil detectors. 2. Autoradiography of effluent sample filters. 3. Determination of plutonium particle size in soil samples. 4. Determination of plutonium particle distribution on grass blades. 5. Study of laboratory contamination by settling dust particles containing alpha activity. 4 references, 4 figures, 1 table.

35704 **(RISO-R—495) Double tracer experiments to evaluate atmospheric transport and dose models.** Nielsen, S.P.; Gryning, S.-E.; Thykier-Nielsen, S.; Karlberg, O.; Lyck, E. (Risoe National Lab., Roskilde (Denmark)). May 1986. 103p. NTIS (US Sales Only), PC A06/MF A01. File Number DE87752180.

Two tracers, sulphurhexafluoride (SF/sub 6/) and radioactive noble gases, were released simultaneously from a 110-m stack and detected downwind at distances of 3-4 km. The experiments were made at the Swedish nuclear power plant Ringhals in 1981. The radioactive tracer was routine emissions from unit 1 (BWR). The one-hour measurements yielded crosswind profiles at ground level of SF/sub 6/-concentrations and of gamma radiation from the plume. The measured profiles were compared to profiles calculated with computer models. The comparison showed that the models sometimes underestimate and sometimes overestimate the results, which seems to indicate that the models within their limited accuracy yield unbiased results. The ratios between measured and calculated values range from 0.2 to 3. The measurements revealed a surplus of gamma radiations from the noble gas daughters compared to those from the gases. This was interpreted as due to ground desposition and the estimated deposition velocities range from 2 to 10 cm/s. The meteorological conditions were monitored from a 100-m meteorological tower and from an 11-m mast. Measurements were made of wind speed, wind direction, and temperatures at different heights, and during each experiment a mini-radiosonde was released giving information on a possible inversion layer. The SF/sub 6/-tracer was injected to the stack prior to the experiments. Air-samples were collected downwind in plastic bags by radio-controlled sampling units. The SF/sub 6/-concentrations in the bags were determined with gas chromatography. Measurements of the gamma radiation from the plume were made with ionisation chambers and GM-counters. Furthermore, a few mobile gamma spectrometers were available giving information on the unscattered gamma radiation, thereby permitting identification of the radioactive isotopes.

35705 **(SAND—87-8210) 1986 environmental monitoring report.** Devlin, T.K. (Sandia National Labs., Livermore, CA (USA)). Apr 1987. Contract AC04-76DR00789. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010028.

SNLL conducts various research activities which have the potential for release of hazardous materials or radionuclides to the environment. Potential emissions include tritium, depleted uranium, metals, solvents, and common laboratory chemicals. SNLL handles gram quantities of tritium, kilogram quantities of depleted uranium, but only microcurie quantities of other isotopes. Airborne tritium released in 1986 during research at the TRL was 760 curies (predominantly the oxide form) and 24 millicuries of tritiated water (HTO) was discharged in the liquid effluent. The quantity of depleted uranium released during 1986 was less than 10 microcuries (or 22 grams - analysis near background level) from both liquid and airborne effluents.

5005 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 35437, 35742

35706 **(PNL—6209) Major vegetation types, climatological data, and solar radiation calculations for Colorado's Brush Creek valley.** Whiteman, C.D.; Lambeth, R.; Allwine, K.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1987. Contract AC06-76RL01830. 42p. (ASCOT—87-1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010637.

In this report we present information on the vegetative cover, climate, and solar radiation for the Brush Creek valley. A brief vegetative survey was made on October 3, 1984, to identify the vegetation types in the lowest 8 km of the valley; the reader is cautioned that this included only a small part of the Brush Creek valley. The intent was to identify the principal vegetation types, with no attempt to use available scientific sampling techniques to determine accurate relative frequencies of the vegetation types. Nevertheless, the site survey has allowed us to identify the major species of vegetation, and to make reasonably accurate differentiations of both major vegetation types on valley surfaces (the valley

floor, two sidewalls, and ridgetops) and the relative abundance of major vegetation types on each surface.

5006 Regulations

REFER ALSO TO CITATION(S) 34976, 35059, 35079

35707 **(PB—87-165254/XAB) Summary of the 1985 EPA (Environmental Protection Agency) national performance audit program on source measurements. Final report.** Streib, E.W.; Logan, T.J.; Midgett, M.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). Dec 1986. 49p. (EPA—600/4-87/001). NTIS, PC A03/MF A01.

See also PB—86-176401.

In 1985, the Quality Assurance Division conducted the National Audits for Stationary Source Test Methods. The audit materials consisted of: a disposable gas cylinder for Method 3 (Orsat analyzer), a calibrated orifice for Method 5 (DGM only), five simulated liquid samples each for Method 6 (SO_2) and Method 7 (NOx), and two coal samples for Method 19A. Participating laboratories sent their data to the Source Branch and in return received a written report comparing their results to EPA's. In the Method 3 audit, each parameter had only one concentration. The mean for CO_2 was 4.0% from the expected (EPA) value. The mean for O_2 was 0.4%. In the Method 5 audit, the mean value for all participants differed by 10.6% from the expected value. For the Method 6 audit, the average mean differed by 10% from the expected value, and in the Method 7 audit the average mean differed by 4.0%. In the two coal audits, the parameters measured were sulfur, moisture, ash, and Btu content. On the average for the sulfur analysis, 87% of the participants measured within 10% of the expected value; for Btu, 98% of the participants measured within 10% of the expected value.

35708 **(PB—87-167094/XAB) Federal regulations relevant to asbestos pollution control.** Cain, W.C.; Wilmoth, R.C. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Mar 1987. 18p. (EPA—600/D-87/075). NTIS, PC A02/MF A01.

Health effects and epidemiological studies have established that breathing asbestos fibers can cause asbestosis, lung and other organ cancers, and mesothelioma. This has led to publication by EPA's Office of Toxic Substances of guidance for minimizing airborne asbestos exposure in buildings, establishing the School Rule, proposing a ban on use of certain asbestos-containing materials, and requiring removal of all friable asbestos prior to demolishing buildings. The Asbestos Hazard Emergency Response Act of 1986 requires EPA to make rules in several areas related to asbestos hazards abatement which are covered by recommendations in the guidance documents. EPA is also required to study asbestos exposures in public and commercial buildings and recommend to Congress whether or not the same rules should apply to them as to schools. Responsibility for making laws and enforcing the compliance with these rules will become that of the individual State governments.

35709 (TVA/ONRED/AWR—87/15, pp 53-56) **Acid rain control - legislation and implementation issues.** Montgomery, T.L. (Tennessee Valley Authority, Knoxville). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Most acid rain legislation proposed in the 1980s has been based on 1980 emissions data. SO_2 emissions in the US in 1980 were 26.6 million tons and NO/sub x/ emission were 21.3 million tons. Utilities were significant emitters with 17.4 and 6.2 million tons of SO_2 and NO/sub x/, respectively; the transportation sector was responsible for 9.4 million tons of NO/sub x/. If the utility industry is required to reduce SO_2 and NO/sub x/ emissions to control acid rain, flexibility in the way emission reductions are taken will be very important in minimizing control costs. The effectiveness of the principle of minimal cost with maximum control flexibility has been demonstrated in a report prepared by TVA as a part of the EPA sponsored State Acid Rain (STAR) study effort. Four different SO_2 control approaches - a systemwide annual tonnage cap, a Statewide annual tonnage cap, a plantwide annual tonnage cap, and a plantwide emission rate - with decreasing control flexibility were studied by TVA.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

35710 **(NP—7752433) Federal Research Institute for Agriculture, Braunschweig-Voelkenrode (FAL). Annual report 1985.** (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany, F.R.)). 1986. 194p. (In German). NTIS (US Sales Only), PC A09/MF A01. File Number DE87752433.

The research aims in the different research areas are: Maintaining and improving the soil productivity. Ensuring profit and improving the product quality of agricultural plants. Maintaining and making use of plant genetics resources. Development of environmentally acceptable processes in plant production. Detecting and assessing foreign and noxious substances in agrarian eco-systems. Development of feeding and care processes for valuable animals. Optimising work and production processes in keeping animals. Development of technical processes for obtaining, treating and converting agrarian products and for using remainders and waste materials. Suitable cheap agricultural buildings suitable for animals. Reducing damage and the risk of accidents to people working in agriculture, and making use of economic and social science information for production, people and policies in the agrarian sector.

35711 **(SAND—85-1316) Theoretical development for the mapping of moisture fronts in the heated block experiment.** Wayland, J.R.; Lee, D.O. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1987. Contract AC04-76DP00789. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009490.

Mathematical expressions are developed for utilization in the analysis of field data. Expressions are given for anomalous zones and for layer earth models bounded on four sides by reflecting planes. The purpose of this document is providing, for those knowledgeable in electromagnetic theory, the necessary background to extend the buried electrode concept to geophysical applications.

5101 Basic Studies

REFER ALSO TO CITATION(S) 34672, 34716, 35810

35712 **(CONF-8505356—1) Predicting ecosystem properties from physical data: A case study of nested soil moisture-climatic gradients along the Appalachian chain.** Pastor, J.; Huston, M. (Minnesota Univ., Duluth (USA). Natural Resources Research Inst.; Oak Ridge National Lab., TN (USA)). 1985. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009682.

From Man and the biosphere workshop on remote sensing; Athens, GA, USA (15 May 1985).

The ultimate goal of biological remote sensing is to monitor and predict spatial and temporal variation of biomass and productivity. While direct measurement of greenness has shown the value of remote sensing in arid regions, problems with multilayered canopies and the required ground truth data may limit the applicability of this direct approach. An alternative approach is to combine direct measurements with models that estimate biomass and primary production from physical parameters obtainable from remote sensing as well as other sources, and that have been or can be validated in the field. Variability within units resolved by remote sensing techniques may be critical for estimating landscape-scale properties. Models can be the critical link between regional remote sensing and validation at a few intensively studied sites. As an example of this approach, we will discuss how a particular model can be used to assess the influence of soil moisture gradients nested within climatic gradients on ecosystem properties.

35713 **(DP-MS—86-210) Color infrared video mapping of upland and wetland communities.** Mackey, H.E. Jr.; Jensen, J.R.; Hodgson, M.E.; O'Cuilinn, K.W. (Savannah River Lab., Aiken, SC (USA); South Carolina Univ., Columbia (USA). Dept. of Geography; Coyote (E.) Enterprises, Inc., Mineral Wells, TX (USA)). 1987. Contract AC09-76SR00001. 15p. (CONF-8704136—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010202.

From 11. biennial workshop on color aerial photography in the plant sciences; Weslaco, TX, USA (27 Apr 1987).

Color infrared images were obtained using a video remote sensing system at 3000 and 5000 feet over a variety of terrestrial and wetland sites on the Savannah River Plant near Aiken, SC. The terrestrial sites ranged from secondary successional old field areas to even aged pine stands treated with varying levels of sewage sludge. The wetland sites ranged from marsh and macrophyte areas to mature cypress-tupelo swamp forests. The video data were collected in three spectral channels, 0.5-0.6 μm, 0.6-0.7 μm, and 0.7-1.1 μm at a 12.5 mm focal length. The data were converted to digital form and processed with standard techniques. Comparisons of the video images were made with aircraft multispectral scanner (MSS) data collected previously from the same sites. The analyses of the video data indicated that this technique may present a low cost alternative for evaluation of vegetation and landcover types for environmental monitoring and assessment.

35714 (TVA/ONRED/AWR—87/15, pp 3) **Southern commercial forests research program.** Bartuska, A. Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

35715 (TVA/ONRED/AWR—87/15, pp 16-17) **Regional responses of red spruce to environmental stress.** McLaughlin, S.B.; Blasing, T.J.; Downing, D.J.; Cook, E.R.; Johnson, A.H.; Adams, H.S. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Long-term growth patterns of red spruce (Picea rubens Sarg.) were analyzed from increment cores collected from over 1000 trees at 48 sites in the eastern US. Principal objectives were the evaluation of the distribution, timing, and uniqueness of observed patterns of decreasing radial growth during the past 25 years and the examination of stand competition and climate as contributing factors to observed changes. The authors analyses focused on historical records of spruce mortality and approximately 200 years of radial growth data to search for historical precedents for current trends. In this work the authors have used time series analysis to detect the temporal frequency of significant negative or positive shifts in radial growth rates, an analysis of relationships between a stand competition index and observed changes in growth and mortality, and modeling of past growth-climate relationships to determine whether recent growth changes could be predicted based on climate. Collectively, these analyses indicate that the observed growth decreases of surviving red spruce trees at northeastern sites with high mortality have been anomalous during the past 20 to 25 years with respect to both historical annual growth patterns and past relationships to climate or stand development at these sites.

35716 (TVA/ONRED/AWR—87/15, pp 18) **Southern Appalachian Research-Resource Management Cooperative: spruce-fir assessment.** Nicholas, N.S.; Zedaker, S.M.; Eagar, C.; White, P.S. (Virginia Polytechnic Institute and State Univ., Blacksburg). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

As part of the SARRMC spruce-fir site and stand assessment project, permanent plots have been established in three study areas (Mount Rogers National Recreation Area of Virginia, Black Mountains of North Carolina, Great Smoky Mountains of Tennessee and North Carolina) with stratification variables including elevation, exposure to prevailing winds, and topography. Initial assessment of overstory stand composition was carried out using hierarchical classification with TWINSPAN (two-way indicator species analysis). The authors analysis from all three study sites produced a dendrogram of four types: spruce, spruce-birch, spruce-birch-fir, and fir-spruce. These communities are elevation dependent, with fir-spruce dominating the highest elevations and spruce the lowest. Live basal areas are highest in the spruce communities, averaging 81 m^2/ha and the lowest in the fir-spruce communities averaging 40 m^2/ha. Tree mortality increases with increasing dominance of Fraser fir. Higher elevations at the Blacks and Smokies are experiencing at least 50% mortality of fir due to balsam woolly adelgid (BWQ) while stands at Rogers/Whitetop have not yet succumbed to BWA attacks.

35717 (TVA/ONRED/AWR—87/15, pp 31) **Modeling linkages between drought and cambial growth in southern Appalachian forest tree species.** Zahner, R. (Clemson Univ., SC). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Meteorological drought impacts tree radial growth through prolonged soil water deficits which can be empirically monitored with simulations using site, climatic, and daily weather information. Radial increment is directly altered by water deficits at specific phenological periods in the differentiation of xylem tissue, through the processes of cambial cell division, cell enlargement, and cell maturation that produce the annual tree ring. These cambial processes can also be monitored through simulation that synthesize the characteristics of tree rings. Radial increment is indirectly affected by water deficits through reduced photosynthesis, translocation, food storage, and other physiological processes that regulate cambial activity. These indirect effects can be parametized in tree growth models. All of the above environmental effects and intrinsic processes can be linked for specific species to characterize the relationships between drought and cambial growth. Such a model should be an invaluable aid to understanding how the more complex interactions of drought and atmospheric pollution together impact tree growth. The Clemson Fordrout model for conifers is given as an illustration, and its adaptation to angiosperms is discussed.

35718 (TVA/ONRED/AWR—87/15, pp 58-59) **Assessing forest productivity in the Great Smoky Mountains National Park using thematic mapper spectral data.** Graham, R.L.; Iverson, L.R.; Cook, E.A. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

The authors are assessing the feasibility of using TM data in conjunction with ground-based spatial information on topography and soil characteristics to predict forest productivity. The great Smoky Mountains National Park was selected as one of the authors study sites because of its long history as a site for ecological research and its wide range of forest types. They are using forest productivity, soils, and topography data collected in 1982 on 128 plots, 20 x 50-m, in the western end of the park. These plots range in elevation from 400 to 1800 m and include all the forest community types found in the park except those in the high-elevation spruce-fir zone. Productivity of the plots varies by a factor of 10.

35719 (TVA/ONRED/AWR—87/15, pp 60-61) **Evaluating spruce-fir mortality in the Southeast with a geographic information system.** Dull, C. (Dept. of Agriculture Forest Service). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Spruce-fir mortality in the Southeast has been evaluated using information collected from aerial photography and validation of this information with random ground sample plots. Aerial photography obtained at a scale of 1 to 12,000 in both color infra-red was interpreted to delineate the boundaries of this spruce-fir type. Within these boundaries, it was further stratified by light (<30 %),

heavy (31 to 70 %) and severe (>70 %) mortality. This information was then transferred to the US Geographical Service 7-1/2 minute topo base series maps. Once the data had been transferred to the base series maps, it was then digitized to be included in a geographic data base. Primary data themes in the data base included the spruce-fir forest type boundaries and mortality strata, transportation networks, drainages, ownership, and topography. Maps were then produced displaying locations of the spruce-fir type and its mortality in relation to other geographic based data.

35720 Water relations and plant size aspects of flowering for Agave deserti. Nobel, P.S. (Univ. of California, Los Angeles). *Botanical Gazette (Chicago);* **148**: No. 1, vp(Mar 1987). Contract AC03-76SF00012.

The percentage of rosettes of the monocarpic perennial Agave deserti that flowered annually in the north-western Sonoran Desert varied ca. 50-fold for the 8 yr considered. The number of days when the soil water potential in the root zone was above -0.5 MPa, enabling A. deserti to take up water, was approximately linearly related to the annual precipitation, which also varied considerably year-to-year. The percentage of flowering in a particular year could not be predicted from the number of wet days in that year, the year before, or 3 yr before ($r^2 \leqq .10$, $P > .5$), but there was a positive correlation between percentage of flowering and the number of wet days 2 yr previously ($r^2 = .33$, $P = .1$). Also, years with much flowering tended to alternate with those of little flowering ($r^2 = .64$, $P = .05$). Indeed, 95% of the annual variation in the percentage of the rosettes that flowered could be accounted for by the year-to-year alternations together with the number of wet days 2 yr before the flowering ($P = .01$). Although over 90% of the rosettes with inflorescences were large, averaging 66 leaves and inflorescences 4 m tall, flowering also occurred for a few small rosettes, averaging only nine leaves and inflorescences only 0.8 m tall. The small flowering rosettes were all attached to large flowering rosettes by rhizomes with living cortical cells, suggesting that a hormone or other chemical signal/condition could be passed to the small rosettes leading to their precocious flowering.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 34548, 34551, 34611, 34620, 34623, 34626, 35294, 35583, 35584, 35585, 35586, 35699, 35747, 35848

35721 (AD-A—178083/2/XAB) Long-term problems of land contaminated by nonradioactive hazardous chemicals: sources, impacts, and countermeasures. Final report. Baes, C.F.; Garten, C.T.; Tolbert, V.R. (Oak Ridge National Lab., TN (USA)). Jan 1987. 198p. (ORNL—6239). NTIS, PC A09/MF A01.

This report examines the environmental behavior and fate of nonradioactive hazardous chemicals, methods for assessing environmental impacts, and alternatives for achieving land decontamination and cleanup. Nonradioactive hazardous chemicals can be reactive, corrosive, or toxic. Reactive chemicals may be explosive, flammable, or capable of undergoing spontaneous change upon exposure to air, water, or a mixture of other chemicals. Toxic chemicals have a high probability of being carcinogenic, mutagenic, teratogenic, or lethal to humans and wildlife. The major pathways of entry into the environment are accidents in handling and storage, industrial accidents, illegal or accidental dumping, leaching from buried toxic wastes, land treatment of waste waters, herbicide and pesticide use, and use of industrial products.

35722 (AD-A—178228/3/XAB) Heavy-metal-contaminated soil treatment: conceptual development. Interim technical report, May 1986-February 1987. Kesari, J.; Puglionesi, P.S.; Popp, S.; Corbin, M.H. (Weston (Roy F.), Inc., West Chester, PA (USA)). Feb 1987. 231p. NTIS, PC A11/MF A01.

Metals-contaminated soils are a problem at many US Army sites. In an effort to identify options for treatment of heavy metal contaminated soils and residues, the US Army Toxic & Hazardous Materials Agency (USATHAMA) initiated this study which is an evaluation of treatment technologies that may be candidates for further research and development. The first part of the study involved the characterization of soil-metal concentrations at the various sites and a review of applicable regulations guidelines/criteria for residual soil-metal concentrations. These characterizations indicated that several Army installations had elevated total metal concentrations in their soils and chromium, cadmium and lead were the most prevalent. This feasibility screening resulted in the following technologies being selected for further research and development: Microencapsulation, Roasting, Extraction.

35723 (AD-A—178261/4/XAB) Installation-restoration general environmental technology development. Task 4. Bench-scale investigation of air stripping of volatile organic compounds (VOC's) from soil. Final report, May 1985-January 1987. McDevitt, N.P.; Noland, J.W.; Marks, P.J. (Weston (Roy F.), Inc., West Chester, PA (USA)). Jan 1987. 116p. NTIS, PC A06/MF A01.

See also Task 8, AD—A162-528.

This report presents the results of a bench-scale investigation which evaluated the role of aeration in thermal stripping of volatile organic compounds (VOC's) from soil. The project included: process equipment design, development of a test plan, bench-scale investigation, and evaluation of results.

35724 (AD-A—178418/0/XAB) Installation-Restoration Program. Phase 2. Confirmation/quantification. Stage 1 for former Air Force Plant Number 83, Albuquerque, New Mexico. Final report, March 1985-September 1986. (Hart (Fred C.) Associates, Inc., New York (USA)). Sep 1986. 269p. NTIS, PC A12/MF A01.

See also Volume 1, AD—A178-419.

In accordance with the procedures developed for the Department of Defense (DOD) Installation-Restoration Program (IRP), and the EPA's April 1984 Scope of Work, a Phase II, Stage I site investigation was performed at the Former USAF Plant No. 83 in Albuquerque, New Mexico. Investigations were conducted at identified hazardous-waste storage sites and in other areas of the plant. A total of 12 monitoring wells were installed, seven (7) in the upper water-bearing zone and five (5) in the intermediate aquifer. Boreholes were continuously monitored during drilling with an OVA, with select samples being sent to the laboratory for priority-pollutant analysis. Eight (8) samples of the sediment in the San Jose Drain were also obtained for analysis. Two deep wells (DWA-1 and DWA-2) were pumped for 24 hours and water levels measured in several nearby shallow wells in order to evaluate the in-situ permeability of the clay unit. Groundwater samples were obtained from all the wells during this investigation, and three existing monitoring wells at the site.

35725 (CONF-870245—, pp 201-209) Review of in-place treatment techniques for contaminated surface soils. Wetzel, R. (Science Applications International Corp., McLean, VA). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

This paper presents the findings of a study to provide state-of-the-art information on in-place treatment technologies applicable to large quantities of soils near the land surface. Examples of applications are cleanup of spills from materials transport and closure of lagoons or shallow burial sites. The technologies discussed can perform or have the potential to perform attenuation, extraction, immobilization, degradation or reduction of volatilization of a variety of soil contaminants. Some could potentially address wastes that are extremely difficult to treat using more traditional approaches, and some could be of value under only a narrow set of circumstances. While the information in the final report is focused toward treatment of soils in the unsaturated zone, many of the technologies would apply to treatment in the saturated zone with modification of the method of application. The final report details selection of in-place treatment technologies; descriptions of technologies in field, laboratory, and conceptual stages of development; and engineering methods to optimize the effectiveness of in-place treatment. This paper focuses on the technologies themselves including tabular process descriptions, wastes amenable to treatment, status of development, ease of application, potentially achievable levels of treatment and reliability of the technology over the long term.

35726 (CONF-870245—, pp 213-230) **Low temperature thermal stripping of volatile organic compounds from soil: a field demonstration project.** Noland, J.W.; Koltuniak, D.L. (Roy F. Weston, Inc., West Chester, PA). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The US Army Toxic and Hazardous Materials Agency (USATHAMA), located in the Edgewood area of Aberdeen Proving Ground, Maryland, has dual Army responsibility for installation restoration and demilitarization of unserviceable or obsolete chemical agent munitions. It also serves as the lead agency within the US Army Material Command (AMC) for pollution abatement and environmental control technology development. In this role, USATHAMA routinely conducts generic research and development (R & D) studies with wide application to current US Army environmental problems. The low temperature thermal stripping of volatile organic compounds from soil is an example of one of the many successful R & D efforts USATHAMA has conducted.

35727 (CONF-870245—, pp 233-245) **In situ vitrification for decontamination of soils containing PCBs.** Battey, R.F.; Harrsen, J.T. (Bechtel National, Inc., San Francisco, CA). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

An emerging thermal treatment process known as in situ vitrification (ISV) is being developed to immobilize radioactively contaminated soils. ISV is a permanent remedial action that destroys solid and liquid organic contaminants, and incorporates radionuclides and heavy metals into a glass and crystalline form. The essential elements of the process consist of an electrical power system supplying the energy to melt the contaminated soil, a hood to contain gaseous effluents, an off-gas cooling and treatment system, and a process control station. This study presents the results of a hypothetical remedial action on PCB contamination at a relatively shallow site. The remedial work plan involved excavation of a vitrification trench to a depth of 18 feet and backfilling with soil from four of the six contaminated areas on the site. The plan called for two deeper contaminated areas inside a building to be vitrified in place. A detailed list of activities was developed and costs estimated for each. Total costs of ISV for this hypothetical (but typical) site were estimated at $210-220/ton of soil vitrified. Alternative total project costs for disposal of the same quantity of soil in a landfill about 200 miles distant would be about $290/ton. The most significant cost elements were electricity and labor.

35728 (CONF-870245—, pp 389-403) **Technical evaluation of the circulating bed combustor test burn.** Levin, J.E. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

There is a growing interest in emerging innovative incineration technologies that are capable of dealing with hazardous waste site clean up problems. One such technology that is being evaluated by EPA is Circulating Bed Combustion (CBC). In 1985, a test burn was conducted on a CBC unit developed GA Technologies, Incorporated. The sampling and analytical work associated with the test burn was conducted by an independent contractor under direct supervision of EPA Office of Toxic Substances (OTS) personnel. The test burn, which supported GA's application for a TSCA permit, was conducted on waste consisting of soil contaminated with polychlorinated biphenyls (PCB). The purpose of this paper is to describe the PCB technology and the results of the EPA test burn. The concept of circulating bed combustion to treat organic hazardous waste is basically an outgrowth of conventional fluidized bed combustion technology. The CBC system is based on recirculating solids, high combustion gas velocities (roughly 15 to 20 feet per second), and relatively low combustion temperatures (about 1450 to 1800° F), depending on the waste characteristics in the combustion system. The CBC unit is capable of burning solid, liquid, sludge, or gaseous waste streams.

35729 **(DP-MS—86-179) Distribution of degrading chlorocarbon solvents in water and soil in a contaminant plume.** Looney, B.B.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). 1986. Contract AC09-76SR00001. 30p. (CONF-861138—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010163.

From 99. annual meeting and exposition of the Geological Society of America; San Antonio, TX, USA (10 Nov 1986).

Data from a plume of chlorinated organic solvents located beneath the metallurgical fabrication area (M Area) of the Savannah River Plant (SRP) are discussed. The plume studies in M Area include: water samples from over 200 monitoring wells; continuous split spoon sampling from over 20 wells; and soil gas samples and other special samples. Analysis of chlorocarbon constituents, combined with geologic and hydrologic information, indicates that the transport and fate of these organics are influenced by degradation and sorption. Specifically, the mass remaining in the plume and the ratio of constituents suggest that the degradation rates are ordered: tetrachloroethylene (PCE) > = trichloroethylene (TCE), dichloroethylene (DCE) >> PCE or TCE. Using a very simple first order decay rate assumption, the degradation of PCE under "natural" conditions is on the order of 10%/y ($k = 0.1\ y^{-1}$). Further study is needed to determine if a coupling of sorption and degradation is occurring.

35730 **(PB—87-161238/XAB) Technology briefs: data requirements for selecting remedial-action technology.** Nunno, T.; Wilk, L.; Offenhauer, M.; Palmer, S. (Alliance Technologies Corp., Bedford, MA (USA)). Jan 1987. 174p. NTIS, PC A08/MF A01.

The report addresses the data requirements needed to screen, evaluate, design, and construct remedial action technology at hazardous waste sites. The remedial action technologies include controls for air pollution, surface water, leachate, ground water, gas migration, excavation, in-situ treatment, and land disposal. The report consists of two-page summaries or fact sheets on remedial technologies that describe the function, description, design considerations, limitations, technology status, associated technologies, and data needs.

35731 **(PB—87-161279/XAB) Study of vinyl chloride formation at landfill sites in California. Final report, 16 July 1985-15 January 1987.** Molton, P.M.; Hallen, R.T.; Payne, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. 132p. (BNWL—2311206978). NTIS, PC A07/MF A01.

The purpose of this study was to determine if vinyl chloride (VC) detected in air above California landfills is produced in situ. Experiments were performed with N and S California landfill samples and anaerobic-digestor sewage sludge. Test materials were incubated with various chlorocarbons and with ^{13}C-trichloroethylene (TCE) to confirm biological production of ^{13}C-VC. These experiments confirmed the biological dechlorination of chloroethylenes as the most likely route for VC emission from landfills, rather than chemical or photochemical routes, or PVC degradation. Leaching from PVC could be a minor source of VC, though there was less than 0.1% (estimated) plastic in the landfill samples, containing at most 330 ppm of VC monomer. A landfill sample known to produce VC was used to start an anaerobic chemostat using methanol as sole carbon source. The enriched culture resulting was homogeneous, and when incubated with ^{13}C-TCE, produced (13)C-VC, confirmed by GC/MS.

35732 **(PB—87-162855/XAB) Occupational Safety and Health Guidance Manual for hazardous-waste-site activities.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Oct 1985. 135p. (DHHS/PUB/NIOSH—85-115). NTIS, PC A07/MF A01.

The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities is presented. The manual was prepared by NIOSH, OSHA, the United States Coast Guard, and the Environmental Protection Agency. The manual is a guidance document for managers responsible for occupational safety and health programs at inactive hazardous-waste sites. It assumes a basic knowledge of science and experience in occupational safety and

health. The manual is intended for federal, state and local officials, and their contractors. It may be used as a planning tool by government or private individuals, as a management tool by upper managers, as an educational tool to provide a comprehensive overview of all aspects of safety and health protection at hazardous-waste sites, and as a reference document for site personnel who need to review important aspects of health and safety. It is noted that although the manual cites federal regulations, it is not a definitive legal document and should not be taken as such. Topics covered include types of hazards encountered at hazardous-waste sites, planning and organization, training, medical programs, site characterization, air monitoring, personal protective equipment, site control, decontamination, handling drums and other containers, and dealing with site emergencies.

35733 **(PB—87-166526/XAB) Evaluation of flexible-membrane liner seams after chemical exposure and simulated weathering.** Morrison, W.R.; Parkhill, L.D. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). Feb 1987. 297p. NTIS, PC A13/MF A01.

Strength and durability were tested in presently available seaming systems for FML's (flexible-membrane liners). The seams were exposed to selected, simulated environmental conditions over short periods of up to 52 weeks. A total of 37 combinations of supported and unsupported polymeric sheet materials joined by various seaming methods was subjected to 6 chemical solutions, brine and water immersion, freeze/thaw cycling, wet/dry cycling, heat aging, and accelerated outdoor aging. Effects of these environmental conditions were evaluated using shear and peel strength tests before and after exposure. The tests were performed under dynamic load at room temperature and under static dead load at 50°C. In addition, several NDT (nondestructive test) methods were evaluated.

35734 **(PB—87-172664/XAB) Flow through clay liners: model prediction and field observation. Final report, 1 June 1985-30 June 1986.** Miller, C.J. (Michigan State Univ., East Lansing (USA). Inst. of Water Research). 30 Jun 1986. 62p. NTIS, PC A04/MF A01.

Low-permeability liners are typically constructed above hazardous waste landfills to impede the movement of moisture into the waste, thereby reducing the volume of moisture available for leachate generation. Leachate is a potential source of groundwater contamination. One of the primary parameters which must be estimated when assessing the adequacy of a particular liner design is the expected liner leakage. The present report addresses this problem using a numerical model of the general landfill-cover liner problem and data of moisture profiles within the cover liner of a prototype landfill. The model output includes time-dependent leakage rates, cumulative leakage volumes, and moisture profiles for the liner material. The field data of moisture profiles are available for a seven-month period.

35735 **(PB—87-176897/XAB) Liner materials exposed to toxic and hazardous wastes.** Haxo, H.E.; Haxo, R.S.; Nelson, N.A.; Haxo, P.D.; White, R.M. (Matrecon, Inc., Oakland, CA (USA)). 1986. 20p. NTIS, PC A02/MF A01.

Pub. in Waste Management and Research, Vol. 4, 247-264(1986).

This exploratory experimental research project was conducted (1975-1983) to assess the relative effectiveness and durability of a wide variety of liner materials when exposed to hazardous wastes under conditions that simulate different aspects of service in on-land waste storage and disposal facilities. The materials studied included compacted soil, polymer-treated bentonite-sand mixtures, soil cement, hydraulic asphalt concrete, sprayed-on asphalt, and 31 flexible polymeric membranes based on polyvinyl chloride, chlorinated polyethylene, chlorosulfonated polyethylene, ethylene propylene rubber, neoprene, butyl rubber, elasticized polyolefin, and polyester elastomer. Four semicrystalline polymeric sheetings (polybutylene, low-density polyethylene, high-density polyethylene, and polypropylene), though not compounded for use as liners, were included in the study because of their known chemical resistance and use in applications requiring good chemical and aging resistance.

35736 **(PB—87-180576/XAB) Effect of capillarity and soil structure on flow in low-permeability saturated soils at disposal facilities. Report for June 1983-December 1985.** Mixon, F.O.; Damle, A.S.; Truesdale, R.S.; Allen, C.C. (Research Triangle Inst., Research Triangle Park, NC (USA)). Apr 1987. 108p. NTIS, PC A06/MF A01.

Permit applications may be received that propose to place hazardous waste land-disposal facilities in a saturated zone of low-permeability (low-K) soils. This report addresses only movement of the leachate after release from the facility and does not consider those factors relating to the containment afforded by the facility proper. Discussions include: (1) soil characteristics and the influence soil-forming mechanisms have on the types of heterogeneities and anisotropies to be expected in low-K soils; (2) the roles played by the tension-saturated zone, anisotropies, and heterogeneities in subsurface leachate movement; (3) the advantages and disadvantages of various available computer models to simulate leachate movement in the staturated, low-K anisotropic, and heterogeneous cases.

35737 (TVA/ONRED/AWR—87/15, pp 8) **Soil leaching processes in beech and spruce forests in the Great Smoky Mountains.** Johnson, D.W.; Harrison, R.B.; Todd, D.E.; Dearstone, K.C.; Silsbee, D. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

As part of the Integrated Forest Study, research was undertaken to determine the extent to which atmospheric deposition affects soils leaching and soil acidification processes in high-elevation (~1500 m) beech (Fagus grandifolia) and spruce (Picea rubens) forests in the Great Smoky Mountains National Park. First year results show that NO_3^- was the major anion (Measured in μeq/L) in soil solutions (especially in litter and surface horizons) at all sites. The second most important anion (in μeq/L) in the spruce sites was SO_4^{2-}, whereas HCO_3^- was the second most important anion in the beech sites. Marked seasonal pulses of NO_3^- concentration were noted, especially in the beech sites, where autumn NO_3^- concentrations exceeded 1.0 mmol x L vector^1 in surface soil horizon solutions. These NO_3^- pulses markedly reduced pH and HCO_3^- and increased Al^{3+}. The pH values were consistently low (<4.5) and HCO_3^- was absent in solutions from the spruce sites. Potential sources of nitrogen input (Natural and anthropogenic) to these ecosystems are discussed.

35738 (TVA/ONRED/AWR—87/15, pp 27-28) **Neutral models of forest dynamics as baseline cases for assessing effects of acid rain.** Dale, V.H.; Gardner, R.H.; Pastor, J. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Neutral models provide quantitative methods for objectively assessing the importance of individual factors in explaining forest pattern within an appropriate temporal and spatial framework. In a neutral model, only some of the factors thought to influence the system are allowed to affect predicted outcomes. The authors present two neutral models. In the first, the hypothesis is considered that long-term changes in the accumulation of spruce litter, which is low in nitrogen and high in recalcitrant compounds, may decrease the availability of soil nitrogen. Decreased nitrogen availability can lead directly to spruce decline or can predispose the forest to dieback caused by other factors. In the second model, spatial variability in individual tree regeneration and growth is derived from spatial variability in topography and climate. This model is used to project forest type distribution. Comparison of the predicted vegetation pattern with a vegetation map indicates that, for some sites, topography and climate alone cannot explain the measured pattern. Effects of disturbance history and patterns of soil moisture may be the key variables missing from this analysis.

35739 (TVA/ONRED/AWR—87/15, pp 57) **Factors affecting sulfate adsorption in several forest soils.** Harrison, R.B.; Johnson, D.W. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Sulfate retention properties were determined for air-dried subsurface soil samples collected from the Integrated Forest Study sites of differing soil and forest types, atmospheric deposition histories, and physiographic locations. Sulfate adsorption capacity was determined by percolating a 0.25-mM-$CaSO_4$ solution through a column of air-dried soil material. Desorption characteristics and reversibility were determined on these same soils, and adsorption/desorption observations were compared with measurable soil properties. Soils varied widely in SO_4^{2-}, adsorption capacity; several soils were oversaturated with respect to 0.25 mM-$CaCO_4$ while other soils retained as much as 2 mmol kg^{-1} of SO_4^{2-} at that concentration. Sulfate adsorption capacities determined using sequential equilibrations at a constant-solution-SO_4^{2-} concentration compared well with those determined by equilibrating with solutions of variable SO_4^{2-} concentrations. The presence of hydrous oxides of iron and aluminum appeared to be the best indicator of SO_4^{-2} adsorption and potential.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 34628, 35353, 35695, 35696, 35699, 35703

35740 **(DP-MS—87-25) Waste migration in shallow burial sites under unsaturated flow conditions.** Eicholz, G.G.; Whang, J. (Georgia Inst. of Tech., Atlanta (USA)). 1987. Contract AC09-76SR00001. 8p. (CONF-870306—53). NTIS, PC A02. File Number DE87010187.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

Unsaturated conditions prevail in many shallow-land burial sites, both in arid and humid regions. Unless a burial site is allowed to flood and possibly overflow, a realistic assessment of any migration scenario must take into account the conditions of unsaturated flow. These are more difficult to observe and to model, but introduce significant changes into projected rates of waste leaching and waste migration. Column tests have been performed using soils from the Southeastern coastal plain to observe the effects of varying degrees of "unsaturation" on the movement of radioactive tracers. The moisture content in the columns was controlled by maintaining various levels of hydrostatic suction on soil columns whose hydrodynamic characteristics had been determined carefully. Tracer tests, employing Cs-137, I-131 and Ba-133 were used to determine migration profiles and to follow their movement down the column for different suction values. A calculational model has been developed for unsaturated flow and seems to match the observations fairly well. It is evident that a full description of migration processes must take into account the reduced migration rates under unsaturated conditions and the hysteresis effects associated with wetting-drying cycles.

35741 **(EGG—10282-1119) An aerial radiological survey of Ottawa, Illinois and surrounding area, Ottawa Illinois: Date of survey, May 1986.** (EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.). Oct 1986. Contract AC08-83NV10282. 15p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010824.

An aerial radiological survey was conducted over the town of Ottawa, Illinois, located 128 kilometers (80 miles) southwest of Chicago, Illinois, during the period 12 May through 20 May 1986. The object of the survey was to locate any possible radium anomalies in the Ottawa area. The Illinois Department of Nuclear Safety (IDNS) suspected that radium residues from the former Luminous Processes Plant may have been distributed around the town. The IDNS was decontaminating the Luminous Processes Plant site during the aerial survey. Approximately 23 square kilometers (9 square miles) surrounding the town of Ottawa were surveyed. A contour map derived from the aerial data indicated the presence of anomalous radium at 11 locations in and around Ottawa. A copy of the map was given to the IDNS in Ottawa at the end of the survey period. Subsequent to the aerial survey, EG and G Energy Measurements, Inc. (EG and G/EM) obtained a high-altitude aerial photograph of Ottawa on 17 June 1986. The aerial photograph was used as the underlying map for the radiological survey data. 1 ref., 6 figs., 1 tab.

35742 **(RHO-HS-SR—86-13P) Rockwell Hanford Operations environmental surveillance: Annual report, calendar year 1986.** Elder, R.E.; Egert, G.W.; Johnson, A.R.; Osborne, W.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). May 1987. Contract AC06-77RL01030. 154p. NTIS, PC A08/MF A0; 1; GPO Dep. File Number DE87010398.

Environmental surveillance of the Separations Area of Hanford is performed by Rockwell Hanford Operations (Rockwell) to assess and control the impacts of operations. This involves sampling and analysis from the major environmental pathways of exposure to onsite workers. Surveillance activities include sampling and analysis of ambient air, surface water, groundwater, sediments, soil, and biota. External radiation measurements and radiological surveys of waste disposal sites, radiological control areas, and roads are also performed. The 1986 data are summarized below.

35743 **(SAND—87-0605) 1986 environmental monitoring report, Tonopah Test Range, Tonopah, Nevada.** Millard, G.C.; West, G.L. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010534.

The Tonopah Test Range is located about 140 air miles northwest of Las Vegas, Nevada, and covers 624 square miles within the Nellis Air Force Base Bombing and Gunnery Range. The range is used for various USDOE and USDOD program tests that are critical to national defense. Activities that affect the environment are mainly road construction, preparation of instrumentation sites, and disturbance of the terrain from weapons testing. Monitoring of the test range is done routinely by the US Environmental Protection Agency (EPA) to supplement Sandia's monitoring effort associated with Sandia test activities. EPA monitoring results for 1986 indicate that test range operations do not adversely affect the off-site environment or the public.

35744 **(SAND—87-0606) 1986 environmental monitoring report, Sandia National Laboratories, Albuquerque, New Mexico.** Millard, G.; Pei, P.; Felicetti, S.; Gray, C.; Thompson, D.; Phelan, J. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 109p. NTIS, PC A06/MF A01. File Number DE87010535.

Sandia National Laboratories Albuquerque (SNLA) is located south of Albuquerque on Kirtland Air Force Base. Because radionuclides potentially are released in small quantities from its research activities, SNLA has a continuing environmental monitoring program which analyzes for cesium-137, tritium, uranium, alpha emitters, and beta emitters in water, soil, air, and vegetation. Measured radiation levels in public areas were consistent with local background in 1986. A total of 7.5 curies of argon-41 were released as a result of SNLA operations in 1986. The Albuquerque population received an estimated 0.057 person-rem from airborne radioactive releases, whereas it received greater than 40,050 person-rem from naturally occurring radionuclides. A nonradioactive effluent monitoring program has been started at SNLA which includes groundwater, stormwater and sewage monitoring. Results indicate that water quality conformed to USEPA drinking water standards. Preliminary testing of stormwater showed that no pollutants were above minimum detectable levels. A program to investigate potential remedial action sites has been started.

35745 **(UCRL—95153) Radioactive fallout from the Chernobyl nuclear reactor accident.** Beiriger, J.M.; Failor, R.A.; Marsh, K.V.; Shaw, G.E. (Lawrence Livermore National Lab., CA (USA)). 23 Mar 1987. Contract W-7405-ENG-48. 25p. (CONF-870430—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009746.

From International conference on methods and applications of radioanalytical chemistry; Kona, HI, USA (5 Apr 1987).

Following the accident at the nuclear reactor at Chernobyl, in the Soviet Union on April 26, 1986, we performed a variety of measurements to determine the level of the radioactive fallout on the western United States. We used gamma-spectroscopy to analyze air filters from the areas around Lawrence Livermore National Laboratory (LLNL), California, and Barrow and Fairbanks, Alaska. Milk from California and imported vegetables were also analyzed. The levels of the various fission products detected were far below the maximum permissible concentration levels.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 34652, 35437, 35726, 35742, 35743, 35744, 35878

5106 Regulations

REFER ALSO TO CITATION(S) 35732

35746 **(PB—87-162954/XAB) Regulatory development plan, location standards for RCRA (Resource Conservation and Recovery Act) hazardous-waste facilities. Regulatory development plan. Report for 1984-1985.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). Dec 1982. 17p. NTIS, PC A02/MF A01.

The document identifies procedures to implement Section 3004(o) of the Hazardous and Solid Waste Amendments (HSWA) of 1984, which require that design and operating regulations be developed that specify criteria for acceptable location of new and existing treatment, storage, and disposal facilities as necessary to protect public health and the environment. The Agency is required to publish specific guidance criteria identifying areas of vulnerable hydrogeology by May 1986.

35747 **(PB—87-163242/XAB) Guidance on implementation of minimum technological requirements of HSWA (Hazardous and Solid Waste Amendments) of 1984, respecting liners and leachate-collection systems: reauthorization statutory interpretation No.5D. Rept. for 1984-85.** (Environmental Protection Agency, Washington, DC (USA). Office of Solid Waste). 24 May 1985. 31p. (EPA—530-SW-85-012). NTIS, PC A03/MF A01.

The purpose of the document, and associated technical guidance documents, is to provide further interpretation of the minimum technological requirements found in Section 3004(0) and 3015 of the statute as they relate to liners and leachate-collection system.

35748 **(PB—87-163481/XAB) Solvent-waste volumes and characteristics, required treatment and recycling capacity, and available treatment and recycling capacity. Background document for solvents to support 40 CFR Part 268, Land Disposal Restrictions. Final report, 1981-1986.** (Versar, Inc., Springfield, VA (USA)). Nov 1986. 229p. NTIS, PC A11/MF A01.

The document discusses the volumes and characteristics of hazardous solvent waste affected by Land Disposal Restrictions Evaluates the requiried treatment and recycling capacity, and identifies the unused (available) capacity of alternative treatment and recycling technologies for those solvent wastes. From the RIA (Regulatory Impact Analysis) survey data, it was estimated that a total of 2.894 billion gallons will be affected by the restrictions and require alternative treatment and recycling capacity.

35749 **(PB—87-167060/XAB) Treatment of aqueous metal-bearing hazardous wastes.** Grosse, D.W.; Hassan, S.O.; Park, J.E. (Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab.). Mar 1987. 18p. (EPA—600/D-87/081). NTIS, PC A02/MF A01.

The paper describes the work being conducted at USEPA's Test and Evaluation Facility involving the treatment of metal-finishing hazardous wastewaters. This work is part of a comprehensive program supporting the demonstration, testing, and evaluation of treatment process that have the potential to be utilized to meet the forthcoming requirements of the land-disposal restriction of the HSWA, 1984. A variety of unit-treatment processes have been fabricated to offer BDAT (Best Demonstrated Available Technology) in treating hazardous, aqueous-metal-waste streams. These unit processes include lime precipitation, flocculation, clarification, sulfide precipitation, mixed-media filtration, ion exchange, and granular activated-carbon adsorption. The results of the first three test runs are presented.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 34736, 35713

35750 (TVA/ONRED/AWR—87/15, pp 9) **United States EPA aquatic effects research program.** Messer, J.J. (Environmental Protection Agency, Corvallis, OR). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

35751 (TVA/ONRED/AWR—87/15, pp 39) **Rainfall-runoff response classification.** Hawkins, R.H. (Utah State Univ., Logan). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

This study is an attempt to explore the variety and order (if any) in the rainfall-runoff response patterns of small watersheds. Eighty small watershed data sets, averaging 63 rainfall-runoff events were fitted to the empirical equation $Q = C (P - A)/sup B/$ by an interactive least-squares procedure. The coefficients A, B, and C describe the response signature and were used in analyses to detect behavioral consistency and variety. Three extreme pattern were found: (1) complacent response wherein event runoff was consistently dominated by its smallness; only a small fraction of the rainfall became runoff (or C~ 0.01); (2) traditional behavior, where the coefficient B varied from about 1.3 to 2.0, and C from about 0.1 to 0.4, and (3) violent behavior, where A had values in excess of about 0.5 inches, B was close to 1.00, and C was over about 0.5. Some surprising similarities were found between geographically distant watersheds; as were some counterintuitive contrasts. No clear clusters were immediately evident. An appeal was made for rainfall-runoff data sets from eastern forested watersheds. The application of this approach to several current research efforts was proposed. The study is progressing.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 34554, 34555, 34556, 34620, 34623, 34626, 34740, 35074, 35077, 35078, 35294, 35584, 35585, 35586, 35590, 35600, 35681, 35699, 35705, 35724, 35729, 35730, 35734, 35735, 35749, 35852, 35859, 35863, 35878

35752 (CONF-870245—, pp 151-158) **Overview of the Air Force Installation Program.** Main, D.R. (URS Corp., Oak Ridge, TN). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The Installation Restoration Program more commonly referred to as the IRP, is a Department of Defense program established in 1981 for the clean up of past hazardous waste sites that have resulted or have the potential to result in groundwater contamination. Since the author is familiar with and has managed a portion of the Air Force program, this paper will deal with the actions and subsequent outgrowth of the Air Force IRP.

35753 (CONF-870245—, pp 431-438) **Mobile pyroplasma waste destruction units.** Joseph, M.F.; Barton, T.G. (Westinghouse Plasma Systems Canada Inc., Niagara Falls, Ontario). 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

The Pyroplasma destroys liquid organic materials by breaking the molecular structure of waste molecules by using a thermal plasm field. The process is capable of destroying a wide spectrum of liquid organic hazardous wastes. The materials which have been tested are methyl ethyl ketone, ethanol, methanol, carbon tetrachloride, PCBs and trichlorobenzene. Since the process is a mobile unit, the technology can be transported and used in emergency response to clean up hazardous materials spills or to perform waste site cleanups. However, the system can be permanently installed in industrial production lines to alter and/or recycle chemicals or recover energy from waste streams as they are generated.

35754 (CONF-870245—, pp 440-454) **Removal of low levels of mercury from aqueous solutions.** Napier, J.M. 1987. NTIS, PC A19/MF A01. File Number DE87009018.

From Oak Ridge model conference; Oak Ridge, TN, USA (3 Feb 1987).

Broken water lines spilled several hundred thousand gallons of water onto the floor of a mercury-contaminated building. The water became contaminated with variable amounts of mercury (10 to 22,000 μg/L). An attempt was made to develop a treatment process to remove the mercury to less than 2 μg/L. A modified ion-exchange resin process was developed by attaching ferrous sulfide to the resin and then reacting it to form mercurous sulfide. This procedure reduced the mercury to less than 2 μg/L.

35755 (GKSS—85/E/64) **Application of the atomic emission spectrometry with inductively excited plasma torch to the elemental analysis of river sediment cores.** Schoenburg, M.; Berneike, W.; Weitkamp, C.; Michaelis, W. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1986. 11p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-01423.

Special print from Welz, B. (ed.): Fortschritte in der atomspektrometrischen Spurenanalytik. Bd. 2 p. 561-570, VCH-Verlagsges., Weinheim (Germany, F.R.), 1986.

The depth-resolved analysis of sediment cores taken from river regions with essentially unperturbed sedimentation allows conclusions on the history of anthropogenic pollution and on the geochemical background. The present paper describes the analytical procedure, including sampling, sample preparation, and measurement, using a sequential, computer-controlled ICP-AES facility with a high-resolution monochromator.

35756 (PB—87-166203/XAB) **Use of models in managing ground-water protection programs.** Keely, J.F. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). Jan 1987. 84p. (EPA—600/8-87/003). NTIS, PC A05/MF A01.

Mathematical models can be helpful tools to managers of ground-water protection programs. They may be used for testing hypotheses about conceptualizations and to gather a fuller understanding of important physical, chemical and biological processes that affect ground-water resources. The possible outcomes of complex problems can be addressed in great detail, if adequate data are available. The success of these efforts depends on the accuracy and efficiency with which the natural processes controlling the behavior of ground water, and the chemical and biological species it transports, are simulated.

35757 (PB—87-168829/XAB) **Report on the usefulness of AVHRR and CZCS sensors for delineating potential disposal operations at the 106-mile site.** Cornillon, P. (Rhode Island Univ., Kingston (USA). Graduate School of Oceanography). Mar 1987. 14p. (ERLN-X—120). NTIS, PC A02/MF A01.

In this work data from the AVHRR sensor for 18 TIROS-N series satellite passes were examined for signs of ocean dumping at Deepwater Dumpsite 106. The passes selected occurred within five days following the actual dump although in most cases they occurred on the same day or that following the day of the dump. All spectral channels were analyzed. In addition, the difference and the ratio of channels 1 and 2 were used. No dumping is evident in any of the images. If dumping is actually visible, the signal must be very weak at the 1-km resolution of the AVHRR sensor. Because of this, the images would have to be absolutely clear. Small scattered clouds or thick haze add too much variability to detect a weak signal. This renders AVHRR data of marginal value (if of value at all) for such work. Because the exact location of the dumps was not known, it is possible that the signal is detectable.

35758 (PB—87-170452/XAB) **Weak-acid ion exchange for removing barium, radium, and hardness.** Snyder, D.W.; Snoeyink, V.L.; Pfeffer, J.L. (Illinois Univ., Urbana (USA)). 1986. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of American Water Works Association, Vol. 78, No. 9, 98-104(Sep 1986).

Weak-acid resin in the hydrogen form was found to effectively remove barium, radium, and hardness, without increasing the sodium content of the product water. The maximum capacity of the weak-acid resin was about 2.3 times that of strong-acid resin, and much less spent regenerant per unit volume of water treated was produced from a weak-acid column than from a strong-acid column. There are, however, some disadvantages to weak-acid ion exchange: swelling of the resin during exhaustion; the need to use acid-resistant materials; the inability to remove noncarbonate hardness; the necessity of stripping carbon dioxide from the product water and adjusting the pH; and the probable higher cost.

35759 (PB—87-170809/XAB) **Removal of barium and radium from groundwater. Environmental research brief.** Snoeyink, V.L.; Chambers, C.C.; Schmidt, C.K.; Manner, R.F.; Myers, A.G. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). Feb 1987. 10p. NTIS, PC A02/MF A01.

A research project was undertaken to investigate processes for removing barium and radium from drinking water. Special emphasis was placed on ion exchange processes that can be used without adding large concentrations of sodium to the water. The wastes from radium and barium removal processes were also characterized, and processes suitable for treatment of ion-exchange brines were evaluated. The report discusses two ion-exchange processes that can be used for barium and radium removal accompanied by either partial or no hardness removal. The calcium-form, strong-acid ion-exchange resin can be used for barium and radium removal without significant change in hardness or the concentration of other salts. This resin can be regenerated with $CaCl_2$ brine. The radium-selective complexer (RSC) will remove radium without altering hardness or other salt concentration. The capacity of this resin for waters with low total dissolved solids (TDS) (<1000 to 2000 mg/L TDS) is in excess of 30,000 pCi/dry g; however, if the TDS is increased to about 40,000 mg/L, the capacity drops to 200 to 300 pCi/dry g. Thus using this resin to remove radium from spent brine does not appear feasible.

35760 (PB—87-172250/XAB) **Development document for best conventional pollutant control technology effluent limitations guidelines for the pulp, paper, and paperboard and the builders' paper and board mills point-source categories. Final report.** (Environmental Protection Agency, Washington, DC (USA). Industrial Technology Div.). Dec 1986. 277p. (EPA—440/1-86/025). NTIS, PC A13/MF A01.

The document presents the findings of a study of the pulp, paper and paper-board and the builder' paper and board mills point-source categories. The purpose of this study was to develop effluent limitations guidelines representing the best conventional pollutant control Technology (BCT) for existing sources. These regulations were prommulgated on July 9, 1986 (51 FR 24974) under the authority of Sections 301, 304, 306, 307, and 501 of the Clean Water Act (The Federal Water Pollution Control Act Amendments of 1972, 33 USC 1251 et Seq., as amended by the Clean Water Act of 1977, P.L. 95-217 (the Act) and in response to the Settlement Agreement in Natural Resources Defense Council, Inc. v. Train, 8 ERC 2120 (D.D.C. 1976), modified, 12 ERC 2833 (D.D.C. 1979).

35761 **(PB—87-172268/XAB) Development document for final best conventional technology effluent limitations guidelines for the pharmaceutical manufacturing point source category. Final report.** O'Farrell, T.; Hund, F. (Environmental Protection Agency, Washington, DC (USA). Industrial Technology Div.). Dec 1986. 58p. (EPA—440/1-86/084). NTIS, PC A04/MF A01.

The document presents the technical rationale for best conventional technology (BCI) effluent limitations guidelines for the pharmaceutical manufacturing point-source category as required by the Clean Water Act of 1977 (P.L. 95-217, the Act). The document describes the technologies considered as the bases for BCT limitations. Section II of this document summarizes the rulemaking process. Sections III through V describe the technical data and engineering analyses used to develop the regulatory technology options. The costs and removals associated with each technology option for each plant and the application of the BCT cost test methodology are presented in Section VI. BCI limitations bases on the best conventional pollutant control technology are to be achieved by existing direct-discharging facilities.

35762 **(PB—87-177101/XAB) In-situ biorestoration as a ground-water remediation technique.** Wilson, J.T.; Leach, L.E.; Henson, M.; Jones, J.N. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). 1986. 11p. (EPA—600/J-86/305). NTIS, PC A02/MF A01.

Pub. in Ground Water Monitoring Review, 56-64(Fal 1986).

In-situ biorestoration, where applicable, is indicated as a potentially very cost-effective and environmentally acceptable remediation technology. Many contaminants in solution in ground water as well as vapors in the unsaturated zone can be completely degraded or transformed into new compounds by naturally occurring indigenous microbial populations. The key to successful remediation is a thorough understanding of the hydrogeologic and geochemical characteristics of the contaminated area. The need today is for methodology to determine when natural biorestoration is occurring, the stage the restoration process is in, whether enhancement of the process is possible or desirable, and what will happen if natural processes are allowed to run their course.

35763 **(PB—87-179545/XAB) Correlation detectors for selective detection of pollutants in natural waters. Technical completion report.** Anderson, J.L. (Georgia Inst. of Tech., Atlanta (USA). Environmental Resources Center). Jul 1986. 92p. (ERC—02-86). NTIS, PC A05/MF A01.

Theory was developed and experimentally tested for the response of amperometric electrochemical detectors in thin-layer flow channels, and theory was developed and preliminary experiments initiated for the response of spectroelectrochemical correlation detectors in thin-layer flow channels. Experiments were carried out using flow-injection methodology with sufficiently large injected volume to insure attainment of steady-state response. Optimum progression of microelectrode spacing across the array was investigated theoretically. It was shown that the optimum geometry is a uniform array of strip electrodes of equal size and constant spacing. Theory was developed for the correlation detector based on electrochemical and spectrophotometric signals generated simultaneously in a thin-layer detector cell.

35764 **(PB—87-179727/XAB) Transport of dissolved hydrocarbons influenced by oxygen-limited biodegradation. 1. Theoretical development.** Borden, R.C.; Bedient, P.B. (North Carolina State Univ., Raleigh (USA)). 1986. 12p. NTIS, PC A02/MF A01.

Pub. in Water Resources Research, Vol. 22, No. 13, 1973-1982(Dec 1986).

Equations are developed for simulating the simultaneous growth, decay, and transport of microorganisms, as well as the transport and removal of hydrocarbon and oxygen. These equations are solved by conventional numerical techniques to study the impact of microbial kinetics, horizontal mixing, adsorption, and vertical exchange with the unsaturated zone on biodegradation. In the region near the hydrocarbon source, any available oxygen will be rapidly consumed. In the body of the hydrocarbon plume, oxygen transport will be rate-limiting, and the consumption of oxygen and hydrocarbon can be approximated as an instantaneous reaction. The major source of oxygens to the plume appear to be transverse mixing, advective fluxes when adsorption is significant, and vertical exchange with the unsaturated zone.

35765 **(PB—87-179735/XAB) Transport of dissolved hydrocarbons influenced by oxygen-limited biodegradation. 2. Field application.** Borden, R.C.; Bedient, P.B.; Lee, M.D.; Ward, C.H.; Wilson, J.T. (Environmental Protection Agency, Ada, OK (USA). Robert S. Kerr Environmental Research Lab.). 1986. 10p. (EPA—600/J-86/333). NTIS, PC A02/MF A01.

Pub. in Water Resources Research, Vol. 22, No. 13, 1983-1990(Dec 1986).

An existing solute transport model is modified to allow simulation of soluble hydrocarbon transport in groundwater influenced by oxygen-limited biodegradation. The transport model is then applied to an abandoned creosoting site where biodegradation is known to occur. Oxygen exchange with the unsaturated zone and resulting biodegradation is approximated as a first-order decay in hydrocarbon concentration. The loss of hydrocarbon due to horizontal mixing with oxygenated groundwater and resulting biodegradation is simulated by generating oxygen and hydrocarbon distributions independently and then combining by superposition. This procedure is only applicable where absorption of hydrocarbon is negligible. The major transport parameters are obtained by calibrating the model to a chloride plume also present at the site. Simulated oxygen and hydrocarbon concentrations closely matched the observed values. Two cases are presented to illustrate the potential assimilative capacity of shallow aquifers.

35766 (TVA/ONRED/AWR—87/15, pp 10) **Aquatic limiting and fish restoration demonstration program.** Brocksen, R.W.; Britt, D. (Living Lakes, Inc., Washington, DC). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Acidified surface waters can produce stress, decline, and loss of important fish species in North American lakes and streams. The most obvious method to manage this problem is to reduce acidic input to the waters. Unfortunately, it is presently not possible, in many cases, to identify all of the sources of acidity, let alone control them. Irrespective, acidity of surface waters must be addressed if fisheries managers responsible for assuring the continuing productivity of this resource are to be successful. Liming is considered by many to be a temporary measure, requiring post-treatment monitoring and reliming. It does have benefits that can outweigh its shortcoming. Liming has been practiced extensively throughout the world and has, in many cases, resulted in aquatic environments conducive to the growth and reproduction of healthy fisheries. Living Lakes, Inc., was created to combine the best available science with state-of-the-art technology to demonstrate the value of liming to modern lake, stream, and fisheries management. A discussion of the Living Lakes Program activities and plans will be presented.

35767 (TVA/ONRED/AWR—87/15, pp 35-36) **Use of stable sulfur isotopes to identify sulfur sources for a high elevation stream in the Great Smoky Mountains National Park.** Cook, R.B.; Elwood, J.W.; Fry, B.; Turner, R.R. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

The stable sulfur isotope content of bedrock sulfur (pyrite), of atmospheric wet deposition, and of several tributaries to Walker Camp Prong at baseflow was measured to determine the sources of sulfur to the stream. Walker Camp Prong and its tributaries drain the south slope of Mount LeConte. The upper reaches of the stream are acidic, having low pH and alkalinity and high concentrations of aluminum, sulfate, and nitrate. Sulfur isotope measurements of streams draining the Anakeesta formation signify that pyrite contributes between 10 and 25% of the sulfur to the stream, with the balance originating from atmospheric deposition. Preliminary sulfate input/output mass balances for the watersheds under-

lain by phyllite indicate that at least 30 to 40% of the sulfate input from atmospheric deposition is retained by the watersheds. These retention values are a lower limit because the preliminary sulfur isotope measurements do not allow estimation of the mass of pyritic sulfur weathered from the bedrock and because dry deposition was not measured.

35768 (TVA/ONRED/AWR—87/15, pp 37) **Regional distribution estimates for spring and summer chemistry in Southern Blue Ridge Streams.** Kaufmann, P.R. (Oregon State Univ., Corvallis). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

The results of the National Stream Survey Phase I - Pilot in the Southern Blue Ridge - are presented. The survey targeted blueline stream reaches (on quarter-million scale topographic maps) that are not grossly polluted, that drain land areas ≦155 square kilometers and do not flow into or out of a reservoir. A randomized, systematic sample of the upstream and downstream nodes of 54 reaches formed a probability sample of the target population from which regional inferences were made with data collected during the spring and summer of 1985. Cumulative frequency distributions with upper 95% confidence limits are graphically presented for 31 chemical variables relevant to acid deposition impact, including pH, acid neutralizing capacity (ANC), extractable aluminum, sulfate, and nitrate. Some highlights of the results include the findings that 6% of the estimated 2020 target reaches in the Southern Blue Ridge were estimated to have downstream spring average index pH values below 6.6 while half were below 7.03. Based on kilometers of reach, 7.4 % of the 8960 km of target reach length was characterized by pH less than 6.6. Approximately 5 % of the target reaches were estimated to have downstream spring average ANC less than 50μ eq/L, a value often cited as representative of waters high susceptible to acidification. Approximately 80% of reaches appeared to be moderately susceptible, with spring ANC index values less than 200 μeq/L. The spatial distributions of pH, ANC, Cl and SO_4 are discussed with reference to regional geography.

35769 (TVA/ONRED/AWR—87/15, pp 38) **Feasibility of assessing the region impact of acid deposition of surface waters of the Southern Blue Ridge from synoptic survey data.** Eshleman, K.N.; Mitch, M.E.; Messer, J.J. (Environmental Research Lab., Corvallis, OR). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Data from the National Survey Phase I-Pilot Survey, conducted during the spring and summer of 1985 in the Southern Blue Ridge region, provide a statistically unbiased snapshot of chemical conditions of a target population of streams in that region. A method for quantifying the chronic acidification of the stream population was developed which uses the synoptic survey data and an empirical model of acidification. The principal assumption of the aquatic chemical model (first postulated by Henriksen) is that streamwaters have been titrated by an amount of sulfuric acid equivalent to their current concentration, and that historical pH and acid neutralizing capacity can be calculated from current chemical data. The model also allows for increases in sulfate to be compensated by increased production of base cations from exchange or accelerated mineral weathering. Using this approach, the median, historical decline in stream pH potentially attributable to acid deposition was estimated to be 0.09 units. Similarly, 10.0 % of the stream reaches were estimated to have experienced chronic pH declines greater than or equal to 0.20 units. Several important assumptions inherent in the model formulation are discussed including: (1) nitric acid can be neglected because nitrate in streams is biologically controlled, (2) marine and natural sources of sulfate can be neglected, and (3) no secondary effects on water quality from acid deposition have occurred. Possible refinements of the model that use site specific data on watershed hydrology, geochemistry, and soils are also discussed.

35770 (TVA/ONRED/AWR—87/15, pp 40) **Effects of acidification on microbial communities and processes.** Palumbo, A.V.; Mulholland, P.J.; Elwood, J.W.; Ferren, L.A.; Genung, D.M. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Acidified streams (pH <5.0) with elevated aluminum concentrations) in the Great Smoky mountains national Park were found to have lower rates of bacterial production on rocks and leaf material than circumneutral streams. However, epilithic bacterial production did not decline with exposure to acidified conditions for up to 48 hours. Thus, lower bacterial production could result from reduced invertebrate grazing rather than the toxic effects of reduced pH and associated higher aluminum levels. In a grazing experiment, maximum bacterial production was found in an intermediate grazing treatment, indicating that grazing can have a significant effect on bacterial production. The results of litter bag experiments indicated that in acidified systems bacterial production, mass loss rates, and total microbial biomass are significantly reduced. However, reduced rates of bacterial production in acidified streams were also observed experiments where leaf material was protected from invertebrate grazing. In both experiments aluminum accumulation on the leaves at the low pH was significantly greater than that of the high pH site. A three-day reduction in pH, from 5.2 to 4.2, without an increase in aluminum, did not significantly affect epilithic bacterial production. However, a reduced pH accompanied by increased aluminum levels did significantly reduce bacterial production. Thus, the effects of acidification on bacteria may result both from changes in trophic interactions and direct effects of water chemistry, with aluminum playing an important role.

35771 (TVA/ONRED/AWR—87/15, pp 41-42) **Effects of acidification on the macroinvertebrate community of a Southern Appalachian stream.** Rosemond, A.D. (Vanderbilt Univ., Nashville, TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

A study of the effects of acidification on macroinvertebrates was conducted in Walker Camp Prong, a stream in the Great Smoky Mountains National Park. Patterns in community structure were determined from analysis of benthic samples taken quarterly for two years from six sites in Walker Camp Prong. Sites range in baseflow pH from 6.8 to 4.4, with a corresponding range in inorganic monomeric aluminum concentrations from 10 to 300 μg/L. Analysis of benthic samples revealed a significant correlation between density of invertebrates and organic matter content of benthic samples. Taxa richness was positively correlated with density. Diversity of the invertebrate community was significantly positively correlated with pH at sites WP3, WP4, and WP5. Species composition of benthic samples also changed as a function of pH.

35772 (TVA/ONRED/AWR—87/15, pp 43) **Bryophytes in acidic streams: their ecology and ecosystem implications.** Boston, H.L. (Oak Ridge National Lab., Knoxville, TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

35773 (TVA/ONRED/AWR—87/15, pp 44) **Contribution of acidic deposition to contaminants in cistern water supplies.** Olem, H. Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

This study evaluated the effects of acidic deposition on the quality of drinking water obtained directly from precipitation. It was estimated that 10,000 homes in the Tennessee Valley region use cistern water as the main source of household water. Cistern supplies typically include a system for collecting all roof water through a gutter system to a concrete tank. The water is then pumped through house plumbing to kitchen and bath taps. The pos-

sibility of the acidic or soft water leaching contaminants from the household plumbing was evaluated by sampling wet deposition and cistern systems of 25 homes in an area receiving acid rain and 25 additional homes in a nonacid rain area. It was found that lead leached from the plumbing systems in both areas. The cistern tap water in the acid rain area, however, did not exhibit higher lead levels. The acidic rain water was apparently neutralized in the concrete tank so that cistern water was no more acidic than cistern water in the nonacid rain area.

35774 (TVA/ONRED/AWR—87/15, pp 45) **Overview of Laurel Branch liming effects study.** Weaver, T.P. (Tennessee Dept. of Health and Environment, Nashville). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

One of the objectives of the National Acid Precipitation assessment program is to develop mitigative measures for aquatic resources. The program includes a group of projects in certain states which will evaluate the effects of liming on aquatic resources. The State of Tennessee entered into an agreement with the US Fish and Wildlife Service to conduct a liming effects research program on a stream in east Tennessee. Laurel Branch in the Tellico River drainage system was selected for evaluation. The five-year program began in the fall of 1985 with two years scheduled for preliming baseline biotic and abiotic sampling. One year of data collection has been completed. The stream will be limed in the third year. The final year will be dedicated to evaluating past-liming effects. Remote realtime biological and physical data (pH, conductivity and flow) and presently being collected with a Synergetics data collection platform via the NOAA GOES satellite system. Rainbow trout are being used as the test species to evaluate stress during acidic events.

35775 (TVA/ONRED/AWR—87/15, pp 46) **Applications of remote automated biomonitoring to Laurel Branch liming effects study.** McFadden, J.F.; Pennington, W.L.; Morgan, E.L. (Tennessee Technological Univ., Cookeville). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Automated biomonitoring provides a means for measuring in situ fish breathing rate changes to episodic rain events and adds a realtime biological monitoring dimension to remote water quality data. The system discussed uses remote computer-assisted data collection platforms (DCPs) and satellite data retrieval options. Field studies were designed to test different types of in situ fish holding chambers and breathing rate monitors prior to linking the system to streamside DCPs. Results from the field tests were used to fabricate trout breathing rate detectors and to implement six of these devices at each of two water quality DCPs located along Laurel Branch in the Southern Appalachian Mountains. Remote stations are being used to fulfill realtime data needs as part of a five-year study initiated in 1985 by the US Fish and Wildlife Service to evaluate possible ecological changes to future mitigative liming efforts.

35776 (TVA/ONRED/AWR—87/15, pp 47) **Chemistry of streams in the Southern Appalachians.** Elwood, J.W. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

35777 (TVA/ONRED/AWR—87/15, pp 63-64) **Precipitation and stream chemistry in a forested Piedmont watershed.** Peters, N.E.; Shanley, J.B. (US Geological Survey, Doraville, GA). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

From April 1985 to September 1986, wet-only precipitation at two sites and stream samples at two continuously recording discharge stations were collected weekly in a 40-hectare (ha) forested watershed at Panola Mountain State Park, 26 kilometers southeast of Atlanta, Georgia. The weekly sampling was supplemented by more frequent sampling during rainstorms at each gage and at the base of a 3-ha granite outcrop in the headwaters of the basin. Precipitation was acidic with pH ranging from 3.5 to 4.8 and was dominated sy sulfate (SO_4^{2-}) averaging 63 $\mu eq\ L^{-1}$ and nitrate (NO_3^-) averaging 28 $\mu eq\ L^{-1}$. Seasonally high SO_4^{2-} concentrations in precipitation occurred during the summer, averaging 80 $\mu eq\ L^{-1}$ in 1985 and 150 $\mu eq\ L^{-1}$ in 1986. Flowpaths and residence times of water moving through the watershed appear to control the temporal and spatial variability in chemical composition of the stream.

35778 (TVA/ONRED/AWR—87/15, pp 65-66) **Influence of Anakeesta shale upon selected upland streams in the North River Watershed, Monroe County, Tennessee.** McKinney, A.D. (Tennessee Dept. of Public Health, Knoxville). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

Five upland, cool water tributaries to North River in the Appalachian Mountains of southeastern Tennessee were sampled at intervals from 1978 through 1986, to determine the influence of Anakeesta shales upon macroinvertebrate communities in both disturbed and undisturbed states. Water quality data for seventeen parameters were collected to supplement biological data. Macroinvertebrate data were collected using both qualitative and quantitative methodology. Benthic communities were compared on the basis to total number of taxa, percent composition within the major orders, total number of individuals, diversity (d), and equitability (e). Results demonstrate that water quality and macroinvertebrate community composition has been adversely impacted by disturbance of Anakeesta shale adjacent to the headwaters of Hemlock Branch and McNabb Branch. The two impacted streams are characterized by extreme low pH, elevated acidity, and increased levels of metals; macroinvertebrate community response includes decreased numbers of taxa and individuals and loss of diversity. Three streams in the study area (Laurel, Big Indian, and Sugar Cove Branches) continue to support acidophillic, diverse, and highly productive biological communities.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 34628, 34659, 34685, 35696, 35699, 35705, 35758, 35759

35779 **(DP-MS—86-114) A grid refinement approach to flow and transport modeling of a proposed groundwater corrective action at the Savannah River Plant, Aiken, South Carolina.** Duffield, G.M.; Buss, D.R.; Stephenson, D.E.; Mercer, J.W. (GeoTrans, Inc., Herndon, VA (USA)). 1987. Contract AC09-76SR00001. 46p. (CONF-870252—8). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010198.

From Solving ground water problems with models conference; Denver, CO, USA (10 Feb 1987).

The regional scale model, calibrated by an automatic least-squares procedure, resulted in a set of hydraulic parameter values consistent with other methods. The automatic procedure facilitated the calibration of the model in which ten hydraulic parameters were treated as unknowns. Ground water flow velocities were used to perform particle-tracking analyses. Local scale transport models were developed for the F and H Area seepage basins. The grid refinement technique in conjunction with the parameter estimation method was very effective in the analysis of regional and local flow and transport phenomena. The estimated hydraulic parameters, determined objectively by the automatic procedure, showed excellent agreement with results from other methods. The local scale transport modeling required significant mesh refinements to meet the objectives of the study. Thus, it was necessary to reduce the area of the model domain to maintain cost and computational efficiency. Regional flow phenomena were preserved in the reduced scale models by extracting hydraulic boundaries and parameters from the regional flow model.

35780 **(PB—87-166195/XAB) Risk assessment of exposure to radium and fluoride in Illinois public water supplies.** Hallenbeck, W.H. (Illinois Univ., Chicago (USA)). Dec 1986. 86p. NTIS, PC A05/MF A01.

In June of 1985, the Illinois Environmental Protection Agency petitioned the Illinois Pollution Control Board to suspend the restricted status of certain communities until January 1, 1989. The effect of this proposal would be to raise the Maximum Allowable Concentrations (MAC) of fluoride from 1.8-2.0 mg/1 to 4 mg/1, and combined radium from 5 to 20 pCi/1. The overall objective of the report was to assess the potential health-impacts of these proposed changes in MACs. Pertinent literature and IPCB testimony were evaluated, health impact models were constructed, and individual risks and/or expected cases were calculated for each affected community. There are 107 communities (680,912 people) in Illinois whose water supplies exceed the present Illinois standard of 5 pCi/1 of combined radium. There are 46 communities (53,840 people) in Illinois whose water supplies exceed the present Illinois standard of 1.8 to 2.0 mg/1 of fluoride.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 34736

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 34731, 34732, 34733, 34735, 35437, 35742, 35752, 35779

35781 **(DOE/BP—796) Pacific Northwest Rivers Study: 1986 final report: Idaho.** Allen, S.; Putera, J.; Jazdzewski, C. (Idaho Dept. of Fish and Game, Boise (USA). Program Coordination Bureau). Jan 1987. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87011162.

This report presents a description of the assessment process and findings for each of the resource categories analyzed in the Idaho component of the Pacific Northwest Rivers Study. The resource categories assessed include resident fish, wildlife, natural features, cultural features, and recreation. The Pacific Northwest Rivers Study was initiated to assess the significance of river segments for a variety of environmental values. The expressed purpose of the study is to identify environmental and institutional considerations which might have a bearing on hydropower development in the northwest. Information produced through this study will provide input into a variety of regional and state power planning and resource management activities.

35782 **(DOE/BP—830) Montana Rivers Study data management system: User's manual: Version 1.0, March 1987.** (Morrison-Maierle, Inc., Billings, MT (USA). Computer Services Div.). May 1987. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011163.

The Montana Rivers Study data base represents the compilation of several complex data bases from throughout the state of Montana into one large data base management system. Information pertaining to Fisheries, Wildlife, Recreation, Natural features, and Cultural features along Montana's waterways is readily available through this information management system. This system is written in dBASE III Plus. This manual is intended to help the user gain access to the composite data base.

35783 **(DOE/BP/18952—2) Columbia River white sturgeon (Acipenser transmontanus): Population genetics and early life history study: Final report, January 1, 1986 to December 31, 1986.** Brannon, E.; Setter, A.; Miller, M.; Brewer, S.; Winans, G.; Utter, F.; Carperter, L.; Hershberger, W. (Washington Univ., Seattle (USA). School of Fisheries; National Marine Fisheries Service, Seattle, WA (USA). Northwest and Alaska Fisheries Center). Apr 1987. Contract AI79-84BP18952. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009924.

The 1986 Columbia River white sturgeon investigations continued to assess genetic variability of sturgeon populations isolated in various areas of the Columbia River, and to examine environmental factors in the habitat that may affect early life history success. Baseline data have been collected for three character sets. Twenty-eight loci have been analyzed for differences using electrophoresis, snout shapes were assessed for multivariate distinction, and scute counts have been examined as an index of variability. Fish that reside in the mid-Columbia and lower river have been sufficiently characterized by electrophoresis to compare with up-river areas. To date, few electrophoretic differences have been identified. However, Lake Roosevelt sturgeon sample size will be increased to determine if some of the observed differences from lower river fish are significant. Snout shape has been shown to be easily quantifiable using the digitizing technique. Scute count data initially indicate that variability exists within as well as between areas. Patterns of differentiation of one or more of these data sets may be used to formulate stock transplant guidelines essential for proper management or enhancement of this species. The historical habitat available to sturgeon in the Columbia River has changed through the development of hydroelectric projects. Dams have reduced the velocity and turbulence, and increased light penetration in the water column from less silt. These changes have affected the ability of sturgeon to feed and have made them more vulnerable to predation, which appear to have altered the ability of populations isolated in the reservoirs to sustain themselves. Present studies support the theory that both the biological and physical habitat characteristics of the Columbia River are responsible for reduced sturgeon survival, and justify consideration of enhancement initiatives above Bonneville to improve sturgeon reproductive success.

35784 **(DOE/BP/35097—5) Distribution, abundance, and population dynamics of northern squawfish, walleye, smallmouth bass, and channel catfish in John Bay Reservoir, 1986: Annual progress report.** Beamesderfer, R.C.; Rieman, B.E.; Elliott, J.C.; Nigro, A.A.; Ward, D.L. (Oregon Dept. of Fish and Wildlife, Portland (USA)). Apr 1987. Contract AI79-82BP35097. 126p. NTIS, PC A07/MF A01. File Number DE87011893.

John Day Reservoir was sampled from 25 March to 1 September 1986 using gill nets, trap nets, boat electrofishers, hook and line, and an angler survey to collect 4945 northern squawfish Ptychocheilus oregonesis, 602 walleye Stizostedion vitreum 2894 smallmouth bass Micropterus dolomieui, and 563 channel catfish Icatalurus punctatus. Distribution, abundance and population parameters of each species were examined. One year growth, mortality, and relative year class strength was described.

35785 **(DOE/BP/61747—2) Migrational characteristics of Columbia Basin salmon and Steelhead trout, 1986: Volume 2, Brand Recapture data: Smolt Monitoring Program annual report, 1986.** (Fish Passage Center, Portland, OR (USA)). Mar 1987. Contract AI79-86BP61747. 243p. NTIS, PC A11/MF A01; 1; GPO Dep. File Number DE87009909.

Smolt Monitoring Program Annual Report, 1986, Volume I, describes the results of travel time monitoring and other migrational characteristics of yearling and sub-yearling chinook salmon (Oncorhynchus tshawytscha), sockeye salmon (Oncorhynchus nerka), and steelhead trout (Salmo gairdneri). This volume presents the data from Fish Passage Center freeze brands used in the analysis of travel time for Lewiston, Lower Granite, Lower Monumental, Rock Island, McNary, and John Day dams. Summary of data collection procedures and explanation of data listings are presented in conjunction with the mark recapture data. Data for marked fish not presented in this report will be provided upon request. Daily catch statistics (by species), flow, and sample parameters for the smolt monitoring sites, Clearwater, Lewiston, Lower Granite, Lower Monumental, Rock Island, McNary, John Day, and Bonneville also will be provided upon request.

5206 Regulations

REFER ALSO TO CITATION(S) 35760, 35761, 35780

53 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 34688, 34858

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5502 Biochemistry

REFER ALSO TO CITATION(S) 34743, 34744, 35627, 35783, 35798, 35855

35786 **(AD-A—178949/4/XAB) Development of a plaque assay for Newcastle Disease virus. Memorandum report.** Kournikakis, B.V.; Fildes, J. (Defence Research Establishment Suffield, Ralston, Alberta (Canada)). Feb 1987. 18p. (DRES-SM—1185). NTIS, PC A02/MF A01.

A reliable plaque assay system for virulent strains of Newcastle Disease virus (eg. Type BL, LaSota strain used in vaccines and at DRES as a viral BW simulant) utilizing a continuous monkey kidney cell line (LLC-MK2) is described. The use of a continuous cell line eliminates the added time and inconvenience of preparing primary cell cultures (eg. chick embryo fibroblasts) to quantitate the number of infectious virus particles.

35787 **(BNL—39749) Collection and standardization of crystal structure data by the Protein Data Bank.** Koetzle, T.F.; Abola, E.E.; Bernstein, F.C.; Bryant, S.H.; Weng, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 7p. (CONF-8705105—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010043.

From 1. CODATA workshop on nucleic acid and protein sequencing data; Gaithersburg, MD, USA (3 May 1987).

The Protein Data Bank collects atomic coordinate data and related information from structural studies on biological macromolecules. The great majority of these data result from crystal structure determinations, although a few structures derived from theoretical model calculations are included. Atomic coordinate data are required to be deposited with the Protein Data Bank by the investigators themselves in machine-readable form. In this way errors in the atomic coordinate entries, which typically contain 3-dimensional coordinates for more than 1000 atoms, are minimized. The submitted coordinates are put into a standard format which includes IUPAC-IUB conventional atom and 3-character residue names, essential bond connectivity information, and citations to published papers. Syntactic and numeric checks are run, and each entry is cleared by the depositors before being released for distribution. At present, a major need of the Protein Data Bank community is for the Bank to extend and improve its data checking and evaluation algorithms. Efforts in this area have been limited by manpower constraints in the past, since precedence had always to be given to keeping up with new data and with distributions to customers. With additional Federal Agency support, it now has been possible to expand checking and evaluation efforts. A high priority task is to implement procedures to check exhaustively for significant nonbonded contacts in the crystal. 3 refs., 1 fig.

35788 **(DOE/ER/13114—T2) Regulation of expression of a soybean storage protein subunit gene: Final report.** Thompson, J.F.; Madison, J.T. (Agricultural Research Service, Ithaca, NY (USA). Northeastern Region). 1986. Contract AI05-83ER13114. 12p. NTIS, PC A02. File Number DE87010702.

In an effort to determine why methionine decreases the level of the conglycinin β-subunit in cultured soybean seeds, we have established that: (1) methionine does not accelerate the degradation of the β-subunit; (2) that methionine is probably not acting by methylating the β-subunit gene; (3) that methionine is preventing the appearance of a translatable β-subunit mRNA; (4) that methionine is probably not accelerating the degradation of the β-subunit mRNA; and (5) methionine causes a marked increase in a small (0.7 kb) poly A^+ RNA. 6 refs., 4 figs., 2 tabs.

35789 **Cloning and sequencing of the alcohol dehydrogenase II gene from zymomonas mobilis.** Conway, T.; Sewell, G.W.; Osman, Y.A.; Ingram, L.O. (Univ. of Florida, Gainesville). *Journal of Bacteriology;* **169**: No. 6, 2591-2597(Jun 1987).

The gene which encodes alcohol dehydrogenase II (adhB) from Zymomonas mobilis was cloned in Escherichia coli as a 1.4-kilobase DNA fragment by using a novel indicator plate which directly detects the expression of this activity by recombinant colonies. The DNA sequence for this clone contained an open reading frame encoding a polypeptide of 383 amino acids, with a molecular weight of 40,141. Although this protein exhibited very little homology with other known alcohol dehydrogenases, the predicted amino acid composition was in excellent agreement with that reported for the purified alcohol dehydrogenase II protein from Z. mobilis. In Z. mobilis, the adhB gene was transcribed from tandem promoters which were separated by 100 base pairs and ended with a transcriptional terminator (13-base-pair palindrome). In Escherichia coli, only one of the Z. mobilis promoters was used, despite apparent similarity to the enteric consensus promoter. The adhB gene was transcribed at low levels in E. coli from the P2 promoter of Z. mobilis but was expressed well in E. coli under control of the lac promoter (approximately 0.25% of the total cell protein).

35790 **Small gold-conjugated antibody label: improved resolution for electron microscopy.** Hainfeld, J.F. *Science (Washington, D.C.);* **236**: 450-453(24 Apr 1987).

A general method has been developed to make the smallest gold-conjugated antibody label yet developed for electron microscopy. It should have wide application in domainal mapping of single molecules or in pinpointing specific molecules, sites, or sequences in supramolecular complexes. It permits electron microscopic visualization of single antigen-binding antibody fragments (Fab') by covalently linking an 11-atom gold cluster to a specific residue on each Fab' such that the antigenic specificity and capacity are preserved. The distance of the gold cluster from the antigen is a maximum of 5.0 nanometers when the undecagold-Fab' probe is used as an immunolabel.

5505 Metabolism

REFER ALSO TO CITATION(S) 35849, 35851

5506 Medicine

REFER ALSO TO CITATION(S) 35356, 35360, 35360, 35831, 35835, 36082, 36082

35791 **(BNL—39114) Boronated monoclonal antibody conjugates for neutron capture therapy.** Borg, D.C.; Elmore, J.J. Jr.; Ferrone, S. (Brookhaven National Lab., Upton, NY (USA); New York Medical Coll., NY (USA)). 1986. Contract AC02-76CH00016. 2p. (CONF-861102—46). NTIS, PC A02. File Number DE87008707.

From American Nuclear Society and Atomic Industrial Forum joint meeting; Washington, DC, USA (16 Nov 1986).

This paper describes the effectiveness of ^{10}B-labeled monoclonal antibodies against Colo-38 human melanoma in vitro. The authors obtained high boron to antibody ratios while maintaining antibody activity by using dextran intermediate carriers to link ^{10}B to the antibody. They developed a double cell quasi-competitive binding bioassay to minimize the effects of nonspecific binding of boronated complexes to cells. 1 fig., 2 tabs.

35792 **(DOE/EV/10343—121) Biomedical Computing Technology Information Center (BCTIC): Final progress report, March 1, 1986-September 30, 1986.** (Vanderbilt Univ., Nashville, TN (USA). School of Medicine). 20 Mar 1987. Contract AS05-80EV10343. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010586.

During this time, BCTIC packaged and disseminated computing technology and honored all requests made before September 1, 1986. The final month of operation was devoted to completing code requests, returning submitted codes, and sending out notices of BCTIC's termination of services on September 30th. Final BCTIC library listings were distributed to members of the active mailing list. Also included in the library listing are names and addresses of program authors and contributors in order that users may have continued support of their programs. The BCTIC library list is attached.

35793 **(ISH—24) Placental localization and diplacental transport of radionuclides. Bibliography on diagnosis and therapy in humans and in animal experiments.** Ahrens, E.; Mahn, U.; Howe, S.; Lewis, D.; Stieve, F.E. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Oct 1983. 104p. (In German). NTIS, PC E11; Available from NTIS as TIB/B86-10127.

The aim of this project sponsored by the Ministry of the Interior is to collect all the relevant publications on the subject of the incorporation of radioactive substances in the prenatal stage of development and to evaluate this with respect to the teratogenic effects they result in. The collection is particularly necessary since the possible consequences of both natural radiation and radiation arising through the advances in technology is a topic which is becoming of increasing concern to the general public. This literature collection supplements those of 1976 and 1977 (Strahleninduzierte Teratogenese - Bibliographie und Diaplazentare Passage, Inkorporation radioaktiver Stoffe in der praenatalen Phase) and is primarily composed of publications dealing with the use of radioactive substances in medicine.

35794 **(ISH—61) ^{201}Thallium: clinical application, kinetics and the influence of therapeutic agents. A literature survey on the subject of interactions between radiopharmaceuticals and therapeutic agents.** Flierdt, E. van de; Hinkel, S.; Hoerl, W.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jan 1985. 87p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-10124.

This literature study is giving a survey of basic kinetics of ^{201}Thallium. In addition it contains a short description of various scintigraphic techniques reported by different authors. Another chapter describes the possible influence of therapeutic drugs on thallium-kinetics. Also summarized from literature sources are the possibilities and the value of thallium-scintigraphy for diagnostic use in extracardial diseases.

35795 **(LA-UR—87-1572) A mathematical model of the spread of the AIDS virus.** Hyman, J.M.; Stanley, E.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 42p. (CONF-8706118—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010112.

From 3. international conference on AIDS; Washington, DC, USA (1 Jun 1987).

A mathematical computer model of the spread of the AIDS epidemic in the US is being developed at Los Alamos National Laboratory. This model predicts the spreading of the HIV infection, and subsequent development of clinical AIDS in various population groups. These groups are chosen according to age, frequency and type of sexual contact, population density, and region of the country. Type of sexual contact includes not only the heterosexual, homosexual differentiation but also repeated contacts with such primary partners as spouses. In conjunction with the computer model, we are developing a database containing relevant information on the natural history of the viral infection, the prevalence of the infection and of clinical AIDS in the population, the distribution of people into sexual behavior groups as a function of age and information on interregional contacts. The effects of variable infectiousness and sexual activity during the long period from infection to disease are found to have a major impact on the predictions of the model. 24 refs., 5 figs.

35796 **Flow cytometer measurement of binding assays.** Saunders, G.C. (to Dept. of Energy, Washington, DC). US Patent 4,665,020. 12 May 1987. Filed date 30 May 1984. vp.

A process is described for the immunochemical determination of the amount of antigen present in a sample. The process comprises: providing a known quantity of spheres with antibody coating; providing a quantity of smaller spheres with an antigen coating. The antigen is the same as the antigen present in the sample. The smaller spheres are fluorescently labeled; combining the known quantity of spheres with sample and allowing reaction between the antigen in the sample and the antibody on the spheres to occur for a set time period; and combining an excess of the smaller spheres with the mixture of the spheres and the sample produced in a preceding step and then allowing the reactions of antigen in sample and antigen on the smaller spheres with the antibody on spheres to reach equilibrium.

5507 Microbiology

REFER ALSO TO CITATION(S) 34524, 34525, 35067, 35795

35797 **Separation of Syntrophomonas wolfei from Methanospirillum hungatti in syntrophic cocultures by using Percoll gradients.** Beaty, P.S.; Wofford, N.Q.; McInerney, M.J. (Univ. of Oklahoma, Norman). *Applied and Environmental Microbiology;* **53**: No. 5, 1183-1185(May 1987). Contract AS05-83ER13053.

Percoll gradient centrifugation effectively separated Syntrophomonas wolfei cells from Methanospirillum hungatii cells, resulting in a 70- to 80-fold enrichment of S. wolfei cells relative to M. hungatii cells. The separated S. wolfei cells were viable. Gram quantities of cellular protein which was enzymatically active and had low levels of contamination by the methanogenic cofactor, factor$_{420}$, were obtained.

5508 Morphology

35798 **(DOE/ER/13161—T1) Studies of oligosaccharins: Carbohydrates possessing biological regulatory activity.** Darvill, A.G.; Albersheim, P. (Colorado Univ., Boulder (USA). Dept. of Chemistry). [1985]. Contract AC02-84ER13161. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011203.

Oligosaccharins are complex carbohydrates with biological regulatory activity. This report describes the progress made in isolating and characterizing several oligosaccharins. 15 refs., 2 tabs.

5509 Pathology

REFER ALSO TO CITATION(S) 35795, 35805, 35862

35799 **(PB—87-165221/XAB) Lung-cancer mortality in workers exposed to sulfuric acid mist and other acid mists in steel-pickling operations.** Beaumont, J.J.; Leveton, J.; Knox, K.; Bloom, T.; McQuiston, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1986. 40p. NTIS, PC A03/MF A01.

A total of 1165 steel workers who had been exposed to sulfuric acid and other acid mists during steel-pickling operations were studied to determine whether there was any evidence of respiratory cancer which could be linked to these exposures. These workers had been employed at three large midwestern steel-manufacturing operations where acid was used to remove oxides from newly produced steel. Cancer of the trachea, bronchus, and lung showed increased mortality in this study. Deaths from buccal cavity, pharynx, and larynx cancers were at normal levels. Deaths from nonmalignant respiratory diseases were lower than normal rates. The excess lung-cancer cases occurred both in workers who had been exposed only to sulfuric-acid mists and in those exposed only to other acids. The authors conclude that there was an increased risk of lung cancer in workers exposed to sulfuric acid and in workers exposed to other acids. Continued monitoring of lung-cancer rates is recommended by the authors, since other acids have replaced sulfuric acid to a great degree.

35800 **(PB—87-166989/XAB) Regional deposition of inhaled reactive gases.** Miller, F.J.; Overton, J.H.; Graham, R.C. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Mar 1987. 40p. (EPA—600/D-87/078). NTIS, PC A03/MF A01.

A critical concept in inhalation toxicology involves the determination of dose as the first component for providing a perspective to judge the applicability of various toxicological results to human-exposure conditions. Available experimental data for reactive gases were reviewed, and basic concepts in the formulation of mathematical dosimetry models were discussed. The complexity of factors influencing dose was illustrated as related to rate-constant sensitivity, thickness of the protective layer of the lungs, the choice of anatomical model, ventilatory parameters, and path distance. Results obtained thus far illustrate the feasibility of making interspecies dosimetric comparisons as an integral step in evaluating the toxicity of inhaled reactive gases, assisting in experimental design, and providing sensitivity studies to determine parameters and processes needing additional research.

5510 Physiological Systems

35801 **(AD-A—178067/5/XAB) Scintigraphy for pulmonary capillary protein leak. Final report, 1 October 1981-30 September 1985.** Sugerman, H.J.; Tatum, J.L.; Hirsch, J.I.; Strash, A.M. (Medical Coll. of Virginia, Richmond (USA)). 1 Jun 1986. 25p. NTIS, PC A02/MF A01.

Computerized scintigraphy, employing the gamma camera, has been used to study the dynamics of the pulmonary capillary membrane leak of 99m-technetium-tagged human serum albumin (Tc-HSA). In preliminary canine studies, the severity of an oleic acid-induced albumin leak was proportional to the slope of lung: heart radioactivity ratio and was more sensitive than arterial blood gases or standard chest roentgenograms. This rising ratio is called slope of injury slope index. A number of agents were studied in an attempt to prevent oleic acid-induced pulmonary microvascular injury. Following a series of five control dogs, five dogs each were studied with each of the following agents: methylprednisolone, ibuprofen, the superoxide radical scavenger, MK-44, and, in three dogs, calcium gluconate. None of these agents was able to alter the rise in lung: heart radioactivity ratio following oleic acid injury. A septic pig model was developed for study of bacterially induced ARDS. Septic-induced ARDS and multi-system organ failure are probably secondary to the systemic release of several mediators of inflammation, treatment will probably require a combination of anti-inflammatory agents. This should impact significantly on the mortality and morbidity of septic complications in traumatized combat soldiers.

35802 **Phenomenological models for nitrogen transport in tissues.** Wienke, B.R. (Los Alamos National Lab., NM). *Nuovo Cimento della Societa Italiana di Fisica, [Sezione] D: Condensed Matter, Atomic, Molecular and Chemical Physics, Biophysics;* **8**: No. 4, 417-435(Oct 1986).

Transfer mechanisms and critical pressures are essential elements in decompression calculations and staged procedures. By coupling a multitissue transfer model to fitted critical pressures, decompression data can be synthesized for rapid numerical implementation in applications. Parametric fits to the critical nitrogen pressures are generated f,r the six tissue compartments (5, 10, 20, 40, 80, 120 min) at sea-level with both linear and constant-pressure ratio extrapolations to altitude conveniently effected with the barometer equation. The macroscopic model used to transfer nitrogen in tissues is described and functional forms of the fit equations are motivated. Accurate exponential representations for mantle pressures and the well-known Cross altitude factors are also generated. Fitted critical tensions vary inversely as the approximate fourth root of the tissue half-life and increase linearly with depth. Air mantle pressures decrease exponentially with altitude and inverse temperature. Using bounce dive constraints, a set of single-tissue decay coefficients, which increase logarithmically with depth, are extracted from depth-dependent decompression criteria and contrasted with corresponding multitissue decay parameters. Bend statistics and a decompression titration experiment, which predicts decreasing critical ratios at depth, are discussed. Overlapping predictions of the models and correlations with experiment are identified.

5520 Public Health

REFER ALSO TO CITATION(S) 34553, 35371, 35591, 35592, 35593, 35594, 35595, 35596, 35597, 35598, 35599, 35601, 35602, 35603, 35604, 35605, 35606, 35607, 35608, 35609, 35610, 35611, 35612, 35613, 35614, 35615, 35616, 35617, 35618, 35619, 35620, 35621, 35622, 35623, 35624, 35625, 35626, 35628, 35672, 35746, 35873, 35874, 35875

35803 **(PB—87-163101/XAB) Current Intelligence Bulletins: summaries.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 24 Jul 1986. 30p. (DHHS/PUB/NIOSH—86-124). NTIS, PC A03/MF A01.

Summaries are provided for the 47 Current Intelligence Bulletins issued to date by NIOSH; any revisions in NIOSH policy made after a bulletin was issued are included. Subjects of the bulletins include the following: chloroprene; trichloroethylene; ethylene-dibromide; chrome pigment; asbestos exposure; hexamethylphosphoric-triamide; polychlorinated biphenyls; 4,4'-diaminodipheylmethane; chloroform; radon daughters; dimethylcarbamoyl-chloride; diethylcarbamoyl-chloride; explosive azide hazard; inorganic arsenic; nitrosamines; metabolic precursors of beta-naphtylamine; 2-nitropropane; acryonitrile; 2,4-diaminoanisole; tetrachloroethylene; trimellitic-anhydride; ethylene-thiourea; ethylene-dibromide and disulfiram, toxic interaction; direct blue 6, direct black 38, direct brown 95, benzidine derived dyes; ethylene-dichloride; NIAX catalyst ESN; chloroethanes, review of toxicity; vinyl halides, carcinogenicity; glycidyl ethers; epichlorohydrin; smoking and the occupational environment; arsine poisoning in the workplace; radiofrequency sealers and heaters; formaldehyde; ethylene-oxide; silica flour; ethylene-dibromide; vibration syndrome; glycol ethers; 2,3,7,8-tetrachlorodibenzo-p-dioxin; 1,3-butadiene; cadmium; monohalomethanes; dinitrotoluenes; polychlorinated biphenyls in electrical equipment fires or failures; methylene-chloride; and 4,4' methylenedianiline.

35804 **(PB—87-163374/XAB) NIOSH (National Institute for Occupational Safety and Jealth) report on occupational safety and health for FY 1985, under Public Law 91-596.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 75p. NTIS, PC A04/MF A01.

See also report for FY 1982, PB—84-182534.

The organization of NIOSH itself is briefly described and highlights of the occupational safety and health program conducted by NIOSH during fiscal year 1985 are reviewed. To combat illnesses related to work it is necessary to identify them and to establish various surveillance studies to quantify their existence. Studies conducted include the National Occupational Health Survey of Mines, a national study of coal-workers' pneumoconiosis, a fatal-accident circumstances and epidemiology study. Health-hazard evaluations were made during 1985 concerning occupational lung disease, indoor air quality, musculoskeletal injuries, occupational cancer, hazardous-waste sites, severe occupational traumatic injuries, neurotoxic disorders, and mixed categories such as exposure of roofers to chemicals. Efforts made to control exposures included studies of respirator limitations, protection against fibrous aerosols, vapor breakthrough times, physiological response to wearing protective clothing, ventilation systems, ethylene-oxide control, semiconductor manufacturing, and asbestos removal.

35805 **(PB—87-163879/XAB) Health-hazard evaluation report HETA 86-224-1732, Colorado River, Agency, Parker, Arizona.** Belanger, P.L.; Thoburn, T.W. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Sep 1986. 16p. (HETA—86-224-1732). NTIS, PC A02/MF A01.

A representative of the National Federation of Federal Employees, Local 422, requested a study be made of skin problems being experienced by several employees of the Colorado River Agency that might be linked to transformer oil or polychlorinated biphenyl (PCB) exposures.

35806 **(PB—87-164224/XAB) Evaluation of the effectiveness of NIOSH's (National Institute for Occupational Safety and Health's) health-hazard evaluation program.** (Urban Systems Research and Engineering, Inc., Cambridge, MA (USA)). 30 Jul 1979. 173p. NTIS, PC A08/MF A01.

Some techniques were developed for an ongoing evaluation of the Health Hazard Evaluation (HHE) Program of NIOSH. Such evaluations must begin with a review of the goals of the program. The HHE program was developed to provide a service to employer and employee questionners concerning toxic hazards in the workplace, to generate information to support the standard-setting process, and to improve conditions in the workplace through recommendations for the reduction and elimination of toxic hazards. A large telephone survey was conducted where employees and employers from about 200 companies which were the subject of HHE studies were interviewed. A vast majority of respondents in each class praised the conduct of the evaluations, their thoroughness, and the professionalism and the competence of the NIOSH team as well as their receptiveness to both worker and employer concerns.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 35710, 35788

35807 **(BNL—39714) Role of soil microbial processes in integrated pest management.** Francis, A.J. (Brookhaven National Lab., Upton, NY (USA)). Jan 1987. Contract AC02-76CH00016. 15p. (CONF-8610282—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010065.

From Integrated pest management training program conference; Hyderabad, India (1 Oct 1986).

Soil microorganisms play a significant role in the carbon, nitrogen, phosphorus, and sulfur cycles in nature and are critical to the functioning of ecosystems. Microorganisms affect plant growth directly by regulating the availability of plant nutrients in soil, or indirectly by affecting the population dynamics of plant pathogens in soil. Any adverse effect on soil microorganisms or on the microbial processes will affect the soil fertility, availability of plant nutrients and the overall biogeochemical cycling of elements in nature. Soil microorganisms are responsible for the degradation and detoxification of pesticides; they control many insect pests, nematodes, and other plant pathogenic microorganisms by parasitism, competition, production of antibiotics and other toxic substances. Also, they regulate the availability of major and minor nutrients as well as essential elements. The long-term effects of continuous and, in some instances, excessive application of pesticides on soil fertility is not fully understood. Although much information is available on the integrated pest management (IPM) system, we have very little understanding of the extent of soil microbial processes which modulate the overall effectiveness of various strategies employed in IPM. The purpose of this paper is to review briefly the key microbial processes and their relationship to the IPM system.

35808 **(CEA-CONF—8687) Selection and Studies of a site for a contract food irradiator.** Henon, Y. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Service de Radio-Agronomie). Sep 1986. 6p. (CONF-8608174—2). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752087.

From Workshop on economic feasibility of food irradiation applications; Wageningen, Netherlands (25 Aug 1986).

The success of a contract irradiation business greatly depends on the choice of the plant location. The decision should be primarily based on the market studies indicating the location of the main customers. However sufficient infrastructure should be available and places like harbors generally appear as highly favourable. While the establishment of an electron beam accelerator requires few particular studies, some technical points must be checked before considering the construction of a gamma irradiator. Preliminary technical studies may be needed regarding aspects such as quake hazards and hydreological profile. However, in very rare occurrences only should the data make another choice necessary.

35809 **(CEA-CONF—8689) Dissemination of information on food irradiation.** Henon, Y. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Service de Radio-Agronomie). Sep 1986. 7p. (CONF-8608174—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752086.

From Workshop on economic feasibility of food irradiation applications; Wageningen, Netherlands (25 Aug 1986).

Information is unanimously recognised as the key to a wide acceptance of irradiated food. A case by case approach is necessary as the context may vary greatly from one country to another. Some actions that took place in the particular French situation are reported. The various targets are addressed and the theoretical product adoption process is described. In spite of several encouraging facts, it appears that a lot has yet to be done before any reliable conclusion on the acceptation or rejection of the process can be reached.

35810 **(CONF-8703139—1) Using a model of forest community dynamics for decision making.** Dale, V.H. (Oak Ridge National Lab., TN (USA)). Mar 1987. Contract AC05-84OR21400. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008807.

From Economics of eastern hardwood management conference; University Park, PA, USA (9 Mar 1987).

Management of eastern hardwood forests requires the ability to predict the ecological and economic effects of harvesting. Computer models have been used independently to predict ecological and economic patterns; however, linking the predicted patterns of forest community development with economic models may provide a more reasonable estimate of the commercial value of forests. This linkage requires knowledge of the environmental characteristics, response of trees to changing environmental conditions, and the commercial value of the species. This paper focuses on ways to estimate regional patterns of forest growth and community dynamics in mixed-hardwood forests under various environmental conditions such that the projected estimates of stand volume can be included to economic models. The choice of a model for this exercise was based on a set of criteria suitable for conditions in the northeastern United States.

35811 **(DOE/AL/24970—T1) Transportable cesium irradiator (TPCI): Final safety analysis report: Revision 1.** Andersen, R.; Ezra, B.; Johnson, R.; Lamvermeyer, D. (Foster Wheeler Energy Applications, Inc., Livingston, NJ (USA)). Jul 1986. Contract AC04-84AL24970. 418p. NTIS, PC A18/MF A01; 1; GPO Dep. File Number DE87010073.

This Final Safety Analysis Report describes the Transportable Cesium Irradiator (TPCI) and assesses the hazards associated with its operation. The TPCI consists of a mobile, lead-shielded, irradiation unit with support equipment mounted within an enclosed trailer. The irradiation unit has two basic compartments; a source chamber sized to mate with the transportation cask which houses the source capsules, and an irradiation chamber formed as a large shielded cylinder (drum) with a window. The irradiation chamber is mounted on a large diameter support bearing. As this chamber is rotated its window moves from the product access door, where produce is inserted or extracted, to a position in line with a similar window in the source chamber. When the windows are aligned the produce is irradiated, while the back wall of the irradiation chamber shields the product access door. The TPCI is designed to be transported throughout the continental United States. The transportation cask containing the cesium source capsules is transported separately from the irradiation unit and is installed when the TPCI unit has been readied for operation at a particular site. The transportation cask is a separate unit and is documented in a separate FSAR.

35812 **(DOE/CH/10287—1) Use of gamma radiation as a form of preservation of sweet potatoes: Phase 2: Final report for period January 1, 1986-December 31, 1986.** Tolbert, M.E.M.; Loretan, P.A. (Tuskegee Inst., AL (USA). Carver Research Foundation). Apr 1987. Contract FG02-86CH10287. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87010801.

Effects of gamma radiation and storage time on storage roots of 'Georgia Jet' and 'Jewel' sweet potatoes and on the sweetpotato weevil Cylas formicarius elegantulus (Summers) were studied. The storage roots were irradiated: immediately after harvest and before curing immediately after curing, or after curing plus three months of storage. Storage was at 14 to 16°C with 85 to 90% relative humidity. Sweet potatoes were examined at different stages of storage over nine months for sprouting, storage rot development, flesh color, texture, moisture, carbohydrates, starch granules - cell ultrastructure, ascorbic acid, enzyme activity, peroxidase and poly-

phenol oxidase, protein and organoleptic properties. It was found that sweet potatoes should never be irradiated prior to curing since increased rotting results. No significant difference was found in storage rot development between control and irradiated after curing at doses up to 0.20 kGy. Nutritive components were in most cases not significantly affected by radiation at the four doses studies. Nutritive qualities of moisture, texture, starch, ascorbic acid, sugar, color and enzymes all changed to one extent or another with increased storage time. Irradiation speeds up the process of cell wall collapse and accumulation of cytoplasmic debris, but this also occurs later in the control. Isoelectric focusing results demonstrate that radiation effects on proteins are very small up to a dose of 0.20 kGy. HPLC results indicated that irradiation of the roots caused accumulation of new proteins while impairing the formation of others. Fecundity of the sweetpotato weevil was reduced at 15°C compared to 28°C.

35813 **(DOE/CH/10287—T1) The effect of gamma radiation on the ultrastructure of sweet potatoes (Ipomoea batatas).** Brown, A. (Tuskegee Inst., AL (USA)). Dec 1986. Contract FG02-86CH10287. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011021.

Radiation is being used to increase the storage life of fresh foods. Various doses of gamma radiation were administered to Jewel cultivar sweet potatoes and the effects were monitored by direct observation and by scanning and transmission electron microscopy. Potatoes were divided into two groups: those irradiated immediately after harvest (doses = 0 kGy - 0.4 KGy) and those irradiated one week after harvest (doses = 0 kGy - 0.4 kGy). Potatoes were examined and viewed each month for 7 months. Gross observations included weight, color and texture of the sweet potatoes. Those potatoes irradiated immediately after harvest spoiled faster than those irradiated one week after harvest. Scanning electron microscopy demonstrated several cellular modifications accompanying spoilage. Cell collapse was greatest at the higher radiation doses during the periods of 1 to 5 months post-irradiation. The shape and size of starch granules varied with storage time and radiation levels. The mitochondria, cell walls and plasma membranes appeared normal as seen by transmission electron microscopy until 6 months post-irradiation for potatoes irradiated both immediately after harvest and one week after harvest. Thereafter, degradative changes were observed.

35814 **(DOE/CH/10287—T2) Effects of gamma radiation and storage time on the physical, chemical and sensory qualities of "Georgia Jet" sweet potatoes.** Yakubu, P.I. (Tuskegee Inst., AL (USA)). Dec 1986. Contract FG02-86CH10287. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87011020.

Effect of gamma radiation and storage time on sprouting, rotting, changes in nutritional composition and sensory quality of Georgia Jet Sweet Potatoes were studied. All radiation doses used in the study inhibited sprouting. Sweet potatoes were severely injured at doses of 1.5 and 2.0 kGy and these doses affected their storage life and sensory quality. There was no significant difference in nutrient composition of sweet potatoes irradiated at doses of 0.8, 0.5, 0.1 kGy and the control. A dose of gamma rays of 0.5 kGy and above may not be desirable for sweet potatoes. The optimum dose may lie between 0.5 and 0.1 kGy.

35815 **(ISH—32(ed.3)) Chemiluminescence measurement of cinnamon-, curry-, red pepper- and milk powder as a method to identify ionizing radiation treatment.** Boegl, W.; Heide, L. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Nov 1983. 118p. (In German). NTIS, PC E11; Available from NTIS as TIB/B86-09855.

The findings may be summarized as follows: significant differences in the dose response relationship of the different foodstuffs were found; the chemiluminescence intensity of different foodstuffs irradiated at equal dose levels may vary considerably; in some cases there might be evidence of radiation treatment even 2 months afterwards; after heating, the irradiated foodstuffs showed reduced chemiluminescence intensity. In some cases it is, however, possible to identify previous irradiation of a foodstuff; if irradiated foodstuffs are treated with water vapor, the radicals will react with the water so as to preclude the identification of previous irradiation; UV-irradiation will result in a drastic increase in luminescence intensity, at least in some cases and air oxidation may also increase the luminescence intensity, especially in fatty foodstuffs.

35816 **(ISH—53) Chemoluminescence measurement of 16 spices as a method to identify ionizing radiation treatment.** Heide, L.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Sep 1984. 149p. (In German). NTIS, PC E11; Available from NTIS as TIB/B86-09857.

This report is based on a series of experiments conducted with 16 spices to find out whether the chemiluminescence intensity measurements of the reaction to luminol solution is appropriate as an indicator of treatment with ionizing radiation. For this purpose the optimum conditions of reaction were first assessed for each spice in order to determine the dependence of the chemiluminescence intensity on the radiation dose and storage time after irradiation. Only in garlic the irradiation was not able to be identified any more after 3 days of storage time. In most of the spices it is possible to take proof of radiation exposure even after storage times of more than 2 months.

35817 **(ISH—58) Measurement of thermoluminescence - a new method for detecting radiation treatment of spices.** Heide, L.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1984. 117p. (In German). NTIS, PC E11; Available from NTIS as TIB/B86-09854.

By the experiments described in this report it was examined in 14 different spices to which extent measurements of thermoluminescence intensity of up to 300°C are suitable for detecting treatment with ionizing radiation. The optimal weight of each spice was first determined for a later investigation of the dependence of thermoluminescence intensity on dose and postirradiation storage. In most spices, radiation treatment is detectable as long as after a storage period of over 2 months. In general it may be stated that thermoluminescence measurement is a reliable method for detecting radiation treatment in supplement to chemiluminescence measurement.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 35822, 35823, 35833, 35855

35818 **(AD-A—178042/8/XAB) Synthesis of new prophylactic antiradiation drugs. Annual report, 1 August 1984-31 August 85. Final report, 30 September 1979-31 August 1985.** Bauer, L. (Illinois Univ., Chicago (USA). Medical Center). Aug 1985. 56p. NTIS, PC A04/MF A01.

Syntheses of (1-aryl-2-adamantyl) alkylamines and (2-aryl-2-adamantyl 1) alkylamines from 4-protoadamantanone are described. Conversion of these amines to the corresponding N-substituted 2-mercaptoacetamidines and derivatives is reported.

35819 **(BNL—39618) The risk equivalent of an exposure to-, versus a dose of radiation.** Bond, V.P. (Brookhaven National Lab., Upton, NY (USA)). 1986. Contract AC02-76CH00016. 36p. (CONF-8611150—4). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008448.

From International conference on non-military radiation emergencies; Washington, DC, USA (19 Nov 1986).

The long-term potential carcinogenic effects of low-level exposure (LLE) are addressed. The principal point discussed is linear, no-threshold dose-response curve. That the linear no-threshold, or proportional relationship is widely used is seen in the way in which the values for cancer risk coefficients are expressed - in terms of new cases, per million persons exposed, per year, per unit exposure or dose. This implies that the underlying relationship is proportional, i.e., "linear, without threshold". 12 refs., 9 figs., 1 tab.

35820 **(BNL—39674) Radiation safety systems at the NSLS.** Dickinson, T. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 5p. (CONF-870302—188). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010454.

From Particle accelerator conference; Washington, DC, USA (16 Mar 1987).

This report describes design principles that were used to establish the radiation safety systems at the National Synchrotron Light Source. The author described existing safety systems and the history of partial system failures. 1 fig. (TEM)

35821 **(CONF-8705116—1) A comparison of dose-response models for death from hematological depression.** Morris, M.D.; Jones, T.D. (Oak Ridge National Lab., TN (USA)). 30 Apr 1987. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009679.

From NATO RSG5 meeting; Portsmouth, UK (11 May 1987).

Many radiation-induced lethality experiments that have been published for various mammalian species have been compiled into a database suitable to study interspecific variability of radiosensitivity, dose-rate dependence of sensitivity, dose-response behavior within each experiment, etc. The data compiled were restricted to continuous and nearly continuous exposures to photon radiations having source energies above 100 keV. Also, photon source energy, exposure geometry, and body weight considerations were used to select studies where the dose to hematopoietic marrow was nearly uniform, i.e., < +- 20%. The data base reflects 13 mammalian test species ranging from mouse to cattle. Some 211 studies were compiled but only 105 were documented in adequate detail to be useful in development and evaluation of dose-response models of interest to practical human exposures. Of the 105 studies, 70 were for various rodent species, and 35 were for nonrodent groups ranging from standard laboratory primates (body weight ~5 kg) to cattle (body weight 375 kg). This paper considers seven different dose-response models which are tested for validity against those 105 studies. The dose-response models included: a right-skewed extreme value, a left-skewed extreme value model, log-logistic, log-probit, logistic, probit, and Weibull models. In general, the log transformed models did not improve model performance and the extreme value models did not seem consistent with the preponderance of the data. Overall, the probit and the logistic models seemed preferable over the Weibull model. 30 refs., 8 tabs.

35822 **(DOE/ER/60389—1) Neutron interactions with biological tissue: Annual report, FY-1986.** Caswell, R.S.; Coyne, J.J. (National Bureau of Standards, Washington, DC (USA)). 30 Sep 1986. Contract AI05-86ER60389. 7p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010947.

Information about the physical stage of neutron interactions with tissue through secondary charged particles are discussed. Theoretical calculations whose input includes neutron cross section data; range, stopping power, ion yield, and straggling information; and geometrical properties are used. Outputs are "initial" and "slowing-down" spectra of charged particles, kerma factors, average values of quality factors, microdosimetric spectra, and integral microdosimetric parameters such as y-bar/sub F/, y-bar/sub D, y-bar*. This information is basic to radiological physics, radiation biology, radiation protection of workers, and standards for neutron dose measurement. 19 refs.

35823 **(DOE/EV/01671—94) Theory of RBE: Seventh triennial report, 1 January 1967 to 31 December 1987.** Katz, R. (Nebraska Univ., Lincoln (USA). Dept. of Physics). 1 Jun 1987. Contract AC02-76EV01671. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010008.

This study investigates the probability of inactivation of the sensitive targets of a detector by gamma-rays as a function of dose can be mapped into the region surrounding the path of an energetic heavy ion through the "local dose" deposited by its delta rays. This system yields a detailed picture of the track of a single particle and a means of calculating the action cross-section. The action cross-section may be understood as the probability per unit path length of generating an observed end-point in a medium. We find the action cross-section for heavy ion interaction by radially integrating the probability. Our interpretation branches depending on whether the action cross-section is smaller or greater than its "plateau value", which is the case of cell killing or the induction of chromosome aberrations approaches the geometric cross-sectional area of the nucleus. We refer to the smaller cross-sections as in the track-width regime because of the characteristic appearance of these tracks, like an irregularly spaced string of beads or a hairy rope, respectively, where in nuclear emulsion one counts grains or measures the track width. Our ideas have resulted in a substantial clarification of radiation effects in a variety of detectors, including biological cells. For 1-hit detectors we can predict the high LET response from their response to gamma rays, and conversely we can predict the response to gamma rays if we know the high LET response over an adequate range of bombardments. Biological cells have a more complex structure. We cannot predict their detailed high LET response from their response to gamma rays.

35824 **(DOE/OR/21400—T308) A reasonable approach to concerns about the existence of fission products.** Sanders, J.P. (Oak Ridge National Lab., TN (USA)). 22 Jun 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010715.

This is a lecture addressed primarily to a nontechnical audience which describes characteristics of fission products and hazards associated with their presence in the environment. 1 fig. (DWL)

35825 **(EGG-M—04587) Requirements for beta gamma dose measurement.** Alvarez, J.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-8703135—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009395.

From International conference on radiation dosimetry and safety; Taipei, Taiwan (2 Mar 1987).

The fundamental requirements for dose measurement are discussed for designing a detector that is capable of measuring both beta and gamma dose at a desired depth. A detector that can measure a broad energy range of beta and gamma must, essentially, respond as tissue at the depth of interest. Tissue response requires that photon absorption and electron stopping power be the same or parallel to tissue over the energy range, that back scatter be similar, as well as, having the proper amount of back scatter material, and that the detector have the same angular and depth response as tissue. These requirements restrict both material and configuration selection or require knowledge of the incident spectrum. 10 refs., 6 figs.

35826 **(HEDL-SA—3409) Development of a stand-alone microcomputer based DOE contractor generic radiation worker safety course.** Klos, D.B.; Gardner, P.R. (Hanford Engineering Development Lab., Richland, WA (USA)). 1985. Contract AC06-76FF02170. 76p. (CONF-851145—1). NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010723.

From 9. annual training resources and data exchange conference; Rockville, MD, USA (4 Nov 1985).

Westinghouse Hanford Company (WHC) has developed Computer Based Training (CBT) materials for radiation and industrial safety. First released for general Fast Flux Test Facility in November, 1984. This course has now been taken by nearly 350 people. Completion times for new personnel average around eight hours. The next project undertaken was construction of a Radiation Worker Safety course generic enough for use by all contractors at the Hanford site. The design process of the Hanford site course indicated that the quantity of "DOE common material" may be sufficient to warrant consideration of a larger target population. Specifically, the course will be designed to run on an IBM-PC or compatible computer having 256K RAM, a standard IBM color graphics card or equivalent, a color graphics monitor, and two floppy disk drives or one hard disk. The target student population includes those who routinely work in Radiation Areas, especially crafts people. We are not targeting Health Physics personnel, except, possibly, for introductory training, nor are we directing the course toward "casual" or escorted workers.

35827 (ISH—13) Biochemical indicators of radiation exposure. Pt. 2. A literature study of biochemical alterations of biological material following exposure to X radiation and γ radiation. Stamm, A.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Mar 1982. 240p. (In German). NTIS, PC E15; Available from NTIS as TIB/B86-10116.

In lexicographic form, volume 2 of the literature study reflects all data currently available on biochemical indicators in blood, urine, tissue, organs and cell cultures after their exposure to X-rays and γ-rays. This overview is based on the published results from 58 original studies. The data are quoted in a fixed sequence according to purpose of examination, material, methods, results and references. All dose values are given in units and manner of writing used in the original studies. X-ray and γ-irradiations were performed in vivo on animals and radiotherapy patients and in vitro on blood, urine and cell cultures. The literature study is concluded by a table compiled from all of the biochemical effects presented in this volume and classified by increasing levels of radiation dose. This table is intended as a aide in the selection of a practical biochemical indicator system for the low dose range.

35828 (ISH—51) Evaluation of selected epidemiological studies on collective groups of radiation exposed persons. Kaul, A.; Elsasser, U.; Hinz, G.; Kossel, F.; Martignoni, K.; Nitschke, J.; Stephan, G. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Dec 1984. 60p. (In German). NTIS, PC E09; Available from NTIS as TIB/B86-10122.

An analysis of the literature indicated that further epidemiological studies of stochastic radiation effects are needed to validate and extend the presently known data on the extent of the risk induced by radiation. For this purpose and on account of the availability of dose values and results from medical examinations, the group of occupationally radiation-exposed persons is particularly suitable. Assessments as to the number of persons required for such a study indicate, however, that only such risk coefficients might be found that exceed by a factor 10 those presently assumed. Furthermore, a uniformly large exposure of several rem per year and person would have to occur over a period of two additional decades in order to statistically confirm an increased frequency of disease from radiation exposure.

35829 (ISH—55(ed.2)) Interactions between radiopharmaceuticals and therapeutic agents: Animal experiments on the influence of therapeutic agents on the pharmacokinetics of 99m-Tc-methylene diphosphonate. Flierdt, E. van de; Stumpf, E.; Boegl, W. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Oct 1984. 104p. (In German). NTIS, PC E11; Available from NTIS as TIB/B86-10125.

In this study examined if skeletal uptake, distribution or excretion of 99m-Tc-methylene-diphosphonate (99m-Tc- MDP) will change under the influence of different therapeutic drugs or the state of dehydration. As therapeutic drugs we chose tetracyclines, sympathomimetic drugs, sympatholytic drugs, diuretics, a Ca-antagonist and a corticosteroid. The state of dehydration of the laboratory animals (female Wistar-rats) was achieved by withdrawal of drinking water for 48 hours. The activity was measured in the organs or body compartments blood, kidney, lung, liver, skeletal muscle and femur. The measurements were performed 2 hours after the application of the radiopharmaceutical.

35830 (ISH—65) Chromosome analyses in persons exposed or assumedly exposed 1984. Chang T.; Stephan, G. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Apr 1985. 18p. (In German). NTIS, PC E07; Available from NTIS as TIB/B86-10113.

Chromosome analyses were performed for 23 exposed or assumedly exposed persons. A total of 23,921 cells were evaluated. In 8 cases the observed aberration rate was within a range of spontaneous frequency; in 5 cases the aberration rate corresponded to a whole body dose of <0,08 Gy. Whole body dose values ranging form 0.08 to 0.14 Gy were determined in 6 cases whereas in 3 cases they ranged from 0.16 to 0.2 Gy. In one case the whole body dose was calculated to be 0.27 Gy. The calibration curve for 0.7 MeV neutrons shows a linear course whereby the slope is calculated to be $\alpha=(66.1+-2,3)x10^{-2}$.

35831 (ISH—85) Radiation hygiene. Radiobiological, medical and physical topics of research. Kaul, A.; Baeuml, A.; Boegl, W.; Haubelt, R.; Hinz, G.; Nitschke, J.; Roedler, H.D.; Schmier, H.; Stephan, G.; Winkelmann, I. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Feb 1986. 54p. NTIS, PC E09; Available from NTIS as TIB/B86-10118.

The Medical Radiation Hygiene Division is responsible for recording radiation exposure as a result of the medical application of ionizing radiation and radioactive substances in the Federal Republic of Germany, as well as for clinical evaluation of diagnostic X-ray and nuclear medical procedures considering risk/benefit by assessment of dose to the patient and studying the efficacy and efficiency of the respective methods, radiation therapy included. Further topics of research refer to quality control and assurance in radiology and to investigations on metabolism and dose of incorporated radioactive substances of environmental origin or medical application.

35832 (ISH—87) Validity and reliability of results of epidemiological studies for the estimation of the radiation induced cancer risk. Pt. 1. The radiation-induced lung cancer risk. Schmitt, A.M. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Jan 1986. 155p. (In German). NTIS, PC E14; Available from NTIS as TIB/B86-09965.

By means of epidemiological studies on populations exposed to internal or external exposure of the lung, it has been investigated which results may be expected from epidemiological studies, to which extent these results will be suitable to determine the risk coefficient, and according to which criteria they should be evaluated. Extrapolation of the results of epidemiological studies to the general population or radiation exposed subgroups has been investigated, and from underlying data, uncertainty ranges for risk coefficients for external and internal exposure of the lung have been calculated. Comparison with ICRP risk coefficients indicates that they are within the ranges calculated, but for external exposure of the lung, this applies only to the assumption of a constant annual lung cancer incidence (absolute risk). However, it is assumed that particularly the radiation induced lung cancer risk is proportional to the spontaneous lung cancer risk (relative risk model). In this case, the risk coefficient used by ICRP for the external exposure of the lung and a 25 years' follow-up period would underestimate the life-time risk.

35833 (ISH—89) Establishment of a system for automatic detection of dicentric chromosomes. Loerch, T.; Stephan, G. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Apr 1986. 84p. (In German). NTIS, PC E09; Available from NTIS as TIB/B87-00406.

The scoring of chromosome aberrations in human lymphocytes can be used for dose estimation in cases of radiation exposure. It is the only method for dosimetry using biological parameters that is in practical use. The main disadvantage of this method is the great expenditure of work, which at present still prevents its becoming wide-spread for routine analyses. For that reason a system was designed and built up which realizes all basic hardware functions required for partial automation of chromosome analysis. The high processing speed necessary is made feasible by application of the multi-microprocessor-system 'POLYP' and of special electronics for the direct evaluation of video signals. Simultaneously to the realization of the hardware, algorithms and computer programs for metaphase search and aberration scoring were partly adapted, partly new ones had to be developed. The metaphase finding program is running already with low error rates. The implementation of the chromosome analysis is not yet completed.

35834 **(ISH—91) Transfer of unstable chromosomal aberrations in human peripheral lymphocytes at cell division and their significance for the aberration frequency.** Stephan, G.; Chang Tsangpi. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). Apr 1986. 48p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-00430.

In 48 h cultures, the fraction of human lymphocytes in 2nd mitosis was found to be between 0 and 42.5% (mean value 8.7%). The X-ray exposure from irradiating with 2 Gy resulted in a cell cycle delay which varied from donor to donor. A loss of nearly 50% of dicentric chromosomes and acentric fragments from unstable chromoson.es occurred at cell division, while centric rings were not impeded. When dicentric chromosomes, or acentric fragments are found in 2nd mitosis, they show a characteristic differential staining, which means that chromatids at cell division fall free and are replicated in daughter cells. When plotting dose effect curves of dicentric chromosomes, up to 20% of 2nd mitosis fractions have little influence on the aberration rate. This may be additionally verified as part of the 'biological dosimetry' in a person with 24% of 2nd mitosis. When the rates of dicentric chromosomes exclusively evaluated from 1st mitosis after irradiation with 2.0 Gy were related to the donors age, no age-dependent sensitivity to radiation could be observed. Aberration rates which deviate from person to person are comparable to the results achieved by conventional staining methods.

35835 **(ISH—93) Dosimetry of radiopharmaceuticals.** Elsasser, U.; Dietrich, J.; Henrichs, K.; Roedler, H.D.; Kaul, A.; Schotola, C. (Bundesgesundheitsamt, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene). May 1986. 121p. (In German). NTIS, PC E11; Available from NTIS as TIB/B87-00403.

The effective dose equivalent of the cumulated activity was determined for different organs as a function of the health, age, and sex of the patient. The calculations are based on data from nuclear medical examinations. A linear compartment model with linear differential equations was used whose solution provides the retention functions that can be represented as the sum of exponential functions. The nuclides investigated were: Tc-99m (DMSA, MDP, DPD, HDP, pertechnetates, colloids), I-131 hippurane, Co-58 vitamin B-12, Fe-59 citrate, and Cr-51-labelled erythrocytes.

35836 **(LA-UR—87-1376) Acute and long term health effects of radiation.** Voelz, G.L. (Los Alamos National Lab., NM (USA)). 19 Nov 1986. Contract W-7405-ENG-36. 35p. (CONF-8611150—3). NTIS, PC A03. File Number DE87009005.

From International conference on non-military radiation emergencies; Washington, DC, USA (19 Nov 1986).

This paper covers selected aspects of the acute and long term health effects excluding acute radiation syndrome and carcinogenesis, resulting from exposure to ionizing radiation. The changes addressed in this paper are those witnessed within an organ or whole body rather than at the molecular or even cellular level. They include acute and late health effects. Some of these effects are threshold effects, meaning that the dose must exceed a certain threshold before one sees these effects. Less than the threshold dose results in no observable organ or whole body effect. The severity of the effects correlate directly with the amount of cell damage or cell death that has occurred. 15 refs., 4 figs., 8 tabs.

35837 **(NUREG/CR—4959) Performance testing of extremity dosimeters.** Harty, R.; Reece, W.D.; Hooker, C.D. (Pacific Northwest Lab., Richland, WA (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications). Jun 1987. Contract AC06-76RL01830. 61p. (PNL—6218). NTIS, PC A04/MF A01 - GPO. File Number TI87010897.

The Health Physics Society Standing Committee (HPSSC) Working Group on Performance Testing of Extremity Dosimeters has issued a draft of a proposed standard for extremity dosimeters. The draft standard proposes methods to be used for testing dosimetry systems that determine occupational radiation dose to the extremities and the performance criterion used to determine compliance. The draft standard has been evaluated by testing the performance of existing processors of extremity dosimeters against the standard's proposed criterion. The proposed performance criterion is: absolute value of $B + S \leq 0.35$, where B is the bias (calculated as the average of the performance quotients) of 15 dosimeter measurements and S is the standard deviation of the performance quotients. Dosimeter performance was tested in seven irradiation categories: low-energy photons (general and accident dosimetry), high-energy photons (general and accident dosimetry), beta particles, neutrons, and a mixture category. Twenty-one types of extremity dosimeters (both finger ring and wrist/ankle dosimeters) were received from 11 processors. The dosimeters were irradiated by the Pacific Northwest Laboratory (PNL) to specific dose levels in one or more of the seven categories as specified in the draft standard and were returned to the processors. The processors evaluated the doses and returned the results to PNL for analysis. The results were evaluated against the performance criterion specified in the draft standard. The results indicate that approximately 60% of both the finger ring and the wrist/ankle dosimeters met the performance criterion. Two-thirds of the dosimeters that did not meet the performance criterion had large biases (ranging from 0.25 to 0.80) but small standard deviations (less than 0.15). 21 refs., 3 figs., 20 tabs.

35838 **(PB—87-169694/XAB) Partial inhibition of in vitro pollen germination by simulated solar ultraviolet-B radiation.** Flint, S.D.; Caldwell, M.M. (Utah State Univ., Logan (USA)). 1984. 6p. NTIS, PC A02/MF A01.

Pub. in Ecology, Vol. 65, No. 3, 792-795(1984).

Pollen from four temperate-latitude taxa were treated with UV radiation in a portion of the UV-B (280-320 nm) waveband during in vitro germination. Inhibition of germination was noted in this pollen compared to samples treated identically except for the exclusion of the UV-B portion of the spectrum. Levels similar to maximum solar UV-B found in temperate-latitude areas failed to inhibit pollen germination significantly, while levels similar to maximum solar UV-B found in equatorial alpine locations caused partial inhibition of germination in three of the four taxa examined.

35839 **(PNL—6100-Pt.4) Pacific Northwest Laboratory: Annual report for 1986 to the DOE Office of Energy Research: Part 4, Physical sciences.** Toburen, L.H. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1987. Contract AC06-76RL01830. 71p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87010025.

This 1986 annual report from Pacific Northwest Laboratory describes research in environment, health, and safety conducted during fiscal year 1986. The report again consists of five parts, each in a separate volume. Part 4 includes those programs funded under the title "Physical and Technological Research." The Field Task Program Studies reports in this document are grouped by budget category and each section is introduced by an abstract that indicates the Field Task Proposal/Agreement reported in that section. These reports only briefly indicate progress made during 1985.

35840 (RFP—3990, pp 47-51) **Simulated body fluid solubility of airborne americium and plutonium particles encountered in an inhalation incident and in the environment.** Langer, G. 24 Dec 1986. NTIS, PC A04/MF A01. File Number DE87009472.

In HS & E application technology: Semiannual progress report, January 1985 through June 1985.

Two simulated scenarios were used to investigate the solubility of inhaled americium 214 in the lungs and the solubility of inhaled plutonium 239 in the lungs and stomach. Particle size data were collected to ascertain the relative distribution of the radioactive aerosols in the respirable size range (<3-μm) and above that range. Analyses show percentages of the two elements dissolved. The procedure has potential to predict the inhalation hazard due to these isotope in aerosol form.

35841 **Genetic transformation in the methanogen Methanococcus voltae PS.** Bertani, G.; Baresi, L. (California Institute of Technology, Pasadena). *Journal of Bacteriology;* **169**: No. 6, 2730-2738(Jun 1987).

Mutations causing requirements for histidine, purine, and vitamin B_{12} were obtained in strain PS of Methanococcus voltae (ar-

chaebacteria) upon irradiation with UV or gamma rays. The first two mutations were shown to revert at low frequencies and were sued to demonstrate the occurrence of transformation with homologous, wild-type DNA. The transformation rates obtained for these presumably chromosomal markers were in the range of 2 to 100 transformants per μg of DNA. Mutants resistant to 2-bromoethanesulfonate and to 5-methyl-DL-tryptophan were also isolated.

35842 **Inducible pathway is required for mutagenesis in Salmonella typhimurium LT2.** Orrego, C.; Eisenstadt, E. (Harvard School of Public Health, Boston, MA). *Journal of Bacteriology;* **169**: No. 6, 2885-2888(Jun 1987).

UV mutability of Salmonella typhimurium LT2 was eliminated in the presence of a multicopy plasmid carrying the Escherichia coli lexA$^+$ gene. This result suggests that inducible, SOS-like functions are required for UV mutagenesis in S. typhimurium. S. typhimurium strains carrying either point or deletion mutations in topA had previously been shown to lose their mutability by UV or methyl methanesulfonate. Mitomycin C induction of the Phi(mucB'-lacZ') fusion (a DNA damage-inducible locus carried on plasmid pSE205) in S. typhimurium topA was normal, suggesting that RecA is activated in topA mutants. These observations lead the authors deduce that S. typhimurium has at least one DNA damage-inducible locus in addition to recA that is required for UV mutability.

35843 **Mutagenesis and cytotoxicity in human epithelial cells by far- and near-ultraviolet radiations: action spectra.** Jones, C.A.; Huberman, E.; Cunningham, M.L.; Peak, M.J. (Argonne National Lab., IL). *Radiation Research;* No. 2, 244-254(May 1987).

Action spectra were determined for cell killing and mutation by monochromatic ultraviolet and visible radiations (254-434 nm) in cultured human epithelial P3 cells. Cell killing was more efficient following radiation at the shorter wavelengths (254-434 nm) than at longer wavelengths (365-434 nm). At 254 nm, for example, a fluence of 11 Jm-2 gave 37% cell survival, while at 365 nm, 17 X 10(5) Jm-2 gave equivalent survival. At 434 nm little killing was observed with fluences up to 3 X 10(6) Jm-2. Mutant induction, determined at the hypoxanthine-guanine phosphoribosyltransferase locus, was caused by radiation at 254, 313, and 365 nm. There was no mutant induction at 334 nm although this wavelength was highly cytotoxic. Mutagenesis was not induced by 434 nm radiation, either. There was a weak response at 405 nm; the mutant frequencies were only slightly increased above background levels. For the mutagenic wavelengths, log-log plots of the mutation frequency against fluence showed linear regressions with positive slopes of 2.5, consistent with data from a previous study using Escherichia coli. The data points of the action spectra for lethality and mutagenesis were similar to the spectrum for DNA damage at wavelengths shorter than 313 nm, whereas at longer wavelengths the lethality spectrum had a shoulder, and the mutagenesis spectrum had a secondary peak at 365 nm. No correlation was observed for the P3 cells between the spectra for cell killing and mutagenesis caused by wavelengths longer than 313 nm and the induction of DNA breakage or the formation of DNA-to-protein covalent bonds in these cells.

35844 **A radiological consequence analysis with HEU and LEU fuels.** Woodruff, W.L.; Warinner, D.K.; Matos, J.E. (Argonne National Lab., Argonne, IL). pp 777-795 of Applications in nuclear data and reactor physics. Cullen, D.E.; Muranaka, R.; Schmidt, J. Philadelphia, PA; World Scientific Pub. Co. (1986). (CONF-860202—).

From Workshop on applications in nuclear data and reactor physics; Miramare, Trieste, Italy (17 Feb 1986).

A model for estimating the radiological consequences from a hypothetical accident in HEU and LEU fueled research and test reactors is presented. Simple hand calculations based on fission product yield table inventories and non-site specific dispersion data may be adequate in many cases. However, more detailed inventories and site specific data on meteorological conditions and release rates and heights can result in substantial reductions in the dose estimates. LEU fuel gives essentially the same doses as HEU fuel. The plutonium buildup in the LEU fuel does not significantly increase the radiological consequences. The dose to the thyroid is the limiting dose.

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 34988, 35583, 35643, 35652, 35679, 35688, 35690, 35692, 35710, 35766, 35770, 35771, 35772, 35774, 35775, 35778, 35841

35845 (BNL—39542, pp 44) **Advanced biochemical processes for geothermal brine treatment.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

In this program, toxic metal resistant microorganisms which can thrive in geothermal brine are being investigated for their ability to detoxify geothermal brines. Exploratory studies are also aimed at the development of biochemical treatment processes which will lead to new biotechnology applicable to geothermal residual sludges.

35846 (BNL—39542, pp 48) **Recovery of strategically important metals.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

Experience gained in studies dealing with specific interactions between selected microorganisms and toxic metals at cellular and molecular levels has been applied to the recovery of strategically important metals. In this program, exploratory studies are conducted in which microorganisms are used as tools in the biochemical recovery of strategic metals. The objectives are to learn about the mechanisms which govern the bioaccumulation, chelation and/or solubilification of metals such as chromium, tin, platinum, thorium, uranium and other toxic and rare metals. Current studies have shown that in the interaction between seven different types of microorganisms and eight different metals there exists a high metal selectivity as well as bioaccumulation capacity for the metals tested.

35847 (BNL—39542, pp 49) **Development of specific biochemical chelating agents and processes for the removal of toxic metals.** Jan 1987. NTIS, PC A09/MF A01. File Number DE87008459.

In Environmental Chemistry Division: Annual report, 1986.

The development of metal-binding compounds (chelating agents) useful for the therapy of heavy metal poisoning and decorporation of radionuclides has consisted of two approaches. These are (1) chemical synthesis and (2) biosynthesis (non-challenge and challenge) of chelators by microorganisms. The challenge biosynthesis is a new approach and method for the production of chelators form microorganisms. Strains of Pseudomonas aeruginosa have been challenged with thorium and uranium. Under the experimental conditions at least eight new chelating agents were produced for thorium relative to the control. These new chelators were characterized by gel permeation, thin layer chromatography, and difference spectra. Analogous experiments carried out with uranium indicated a formation of at lest twelve new chelators for uranium relative to the control systems. In vitro bioassays using mouse liver cells of extracts derived from cultures of P. Aeruginosa CSU grown in the presence of thorium have shown that their efficiency in the decorporation of thorium is comparable under identical conditions to that of DTPA and DFA. Similar results have been obtained also with another strain of the same microorganism (PAO-1). Preliminary toxicity tests in vivo (mice) of extracts derived from PAO-1 show that they virtually are nontoxic to mice.

35848 (CONF-870410—24) **Humic substances reduce bioavailability and toxicity of contaminants.** McCarthy, J.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009816.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

The role of humic substances in the aquatic environment on the availability and toxicity of organic and inorganic contaminants is reviewed. Organic contaminants associated with humics appear to be essentially unavailable for uptake by amphipods, daphnids, and fish. Acute toxicity of these compounds is also diminished proportionally. Since the affinity of organic solutes for binding to humics is related to their hydrophobicity, the effect of humics is significant only for compounds with octanol-water partition coeffi-

cients $>10^4$. In most cases, association of toxic metals with humics reduces the uptake and toxic effects of the contaminants. However, complex interactions among the toxicants, humic ligands, other transition metals and major cations in solution, and the carrier proteins on biological membranes make it difficult to generalize and predict any reduction in accumulation and toxicity of metals. Humic substances may have secondary effects on uptake and accumulation of toxicants by biota through their role in altering the transport and fate of pollutants.

35849 (CONF-8609286—Absts., pp 3, Abstract 14) **Development and use of bacterial populations for enhanced degradation of xenobiotic compounds.** Knackmuss, H.J. (Stuttgart Univ., Germany, F.R. Inst. fuer Mikrobiologie). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

35850 (CONF-8609286—Absts., pp 4, Abstract 16) **Accumulation of heavy metal pollutants by microorganisms.** Gadd, G.M. (Dundee Univ., UK. Dept. of Biological Sciences). 1986. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752432.

From BIO Technica '86: 2nd international exhibition and congress for biotechnology; Hannover, F.R. Germany (23 Sep 1986).

35851 (DOE/CE/15270—T2) **Explorations of mechanisms regulating ectomycorrhizal colonization of boron-fertilized pine: Quarterly report, 4/1/87-6/30/87.** Garrett, H.E.; Sword, M.A.; Reid, R.K. (Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife). 1987. Contract FG01-86CE15270. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010793.

Phenolic compounds are produced by the host plant following fungal invasion which inhibit mycorrhizal development. Boron fertilization of the host plant restricts inhibition by either directly complexing with the phenols or through a disruption of the synthesis of phenols by acting on enzyme activities that regulate phenol production. 19 refs.

35852 (DOE/ER/60374—T3) **Effects of elevated CO_2 on Chesapeake Bay wetlands: 2, Gas exchange and microenvironment in open top chambers: Progress report.** Drake, B.G.; Arp, W.; Craig, J.; Curtis, P.S.; Leadley, P.W.; Whigham, D. (Smithsonian Environmental Research Center, Edgewater, MD (USA)). 1987. Contract FG05-85ER60374. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010309.

We are investigating the effects of elevated atmospheric CO_2 on a Chesapeake Bay salt marsh. Our research program uses open top chambers to expose plants in the field to elevated CO_2 and to monitor plant and community responses to this treatment. The design and performance of the open top chambers used in this study are discussed in detail in this report. The microenvironment within the chambers is described, as are the CO_2 delivery system; sampling of gases and measurement of CO_2 concentration; measurement of light and temperature; and data acquisition and analysis. Results from our analysis of the chamber microclimate are presented.

35853 (GKSS—85/E/63) **Analysis of nutritions and harmful elements in spruces by means of optical emission spectroscopy with inductively heated argon plasma torch.** Berneike, W.; Schoenburg, M.; Weitkamp, C.; Michaelis, W.; Rademacher, P.; Bauch, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik; Hamburg Univ. (Germany, F.R.). Ordinariat fuer Holztechnologie). 1986. 12p. (In German). NTIS, PC E07; Available from NTIS as TIB/B87-01424.

Special print from Welz, B. (ed.): Fortschritte in der atomspektrometrischen Spurenanalytik. Bd. 2 p. 505-515, VCH-Verlagsges., Weinheim (Germany, F.R.), 1986.

Inductively coupled plasma optical atomic emission spectrometry (ICP-AES) with acid digestion under pressure was used for the determination of nutrient and toxic elements in soil solutions and in fine roots and growth rings of healthy and affected 80- to 100-year-old spruce. The accuracy of the measurements was secured by comparison with other independent methods. Sample specimens were confirmed as truly representative. Element concentrations were obtained sequentially by scanning and integrating the emission line profiles. Soil solutions of the selected three affected sites clearly show a deficiency in Ca and Mg, in contrast to the healthy site. Macronutrient contents are also low in the fine roots of affected trees. Element patterns in the fine roots of trees of different disease classes from the same site do not differ significantly. The contents of the macronutrients Ca, Mg and K in the woody tissue of spruce from healthy and affected sites are of similar magnitude.

35854 (LA—10650) **Smoking patterns among Los Alamos National Laboratory employees.** Mahoney, M.C.; Wilkinson, G.S. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010827.

Smoking patterns among 5507 employees at Los Alamos National Laboratory were investigated for those who underwent physical examinations by occupational physicians from 1978 to 1983. More male than female employees smoked, although differences in smoking rates between the sexes were not as large as differences observed for national smoking rates. Employees over 40 were more likely to smoke than younger employees, males consumed more cigarettes than did females, and Anglo employees smoked more cigarettes than did Hispanic employees. Highly educated employees smoked less than did less-educated workers, and staff members exhibited the lowest rates of smoking. Smoking cessation programs for Laboratory employees should be directed toward those subpopulations with the highest rates of smoking. 31 refs., 8 figs., 1 tab.

35855 (LA—10741-PR) **Annual report of the Life Sciences Division 1985.** (Los Alamos National Lab., NM (USA)). Mar 1987. Contract W-7405-ENG-36. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87009464.

This report summarizes the research and development of Los Alamos National Laboratory's Life Sciences Division for the calendar year 1985. These activities were performed by groups in the Life Sciences Division and supported by the US Department of Energy, the US Department of Defense, the National Institutes of Health, the Nuclear Regulatory Commission, and private industry. Technical reports related to the current status of projects are presented in sufficient detail to permit the informed reader to assess their scope and significance. Summaries useful to the casual reader desiring general information have been prepared by the Group Leaders and appear in each group overview.

35856 (PB—87-171088/XAB) **Bioavailability of 1-nitropyrene from model coal fly ash and its uptake by alveolar macrophages.** Mumford, J.L.; Tejada, S.B.; Jackson, M.; Lewtas, J. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1986. 12p. (EPA—600/J-86/200). NTIS, PC A02/MF A01.

Pub. in Environmental Research 40, 427-436(1986).

Alveolar macrophage cultures exposed to coal fly ash vapor-coated with 1-nitropyrene were used as a model system to study the bioavailability and the uptake of a nitroaromatic hydrocarbon from coal-combustion emissions. Initially, 1-nitropyrene-coated fly ash and uncoated fly ash were examined for cytotoxicity using rabbit alveolar macrophages and for mutagenicity in the Salmonella typhimurium plate incorporation assay. The results were compared to determine the effects of vapor deposition. The distribution and recovery of 1-nitropyrene from macrophage cultures treated with coated fly ash were determined by using a reverse-phase high-performance liquid chromatography-fluorescence method. 1-Nitropyrene alone was not very toxic, nor did vapor deposition of 1-nitropyrene onto coal fly ash significantly affect the toxicity of the fly ash. Most toxicity resulted from the original, uncoated, fly ash par-

ticles, 1-Nitropyrene after being coated onto the particles was bioavailable in agar and aqueous culture medium. The coated fly ash showed mutagenic activity when the particles were tested directly; the uncoated fly ash did not show mutagenic activity. 1-Nitropyrene recovery from alveolar macrophage cultures exposed to the coated fly ash diminished as cell number increased. The rate of 1-nitropyrene loss was 2.7 ng/.000001 macrophages for medium and 4.1 ng/.000001 macrophages for the whole culture. The mutagenic activity recovered from these macrophage cultures also decreased with increasing cell number.

35857 **(PB—87-172631/XAB) Effects of maternal exposure of rainbow trout to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) on reproduction. Final report, 1 June 1985-30 June 1986.** D'Itri, F.M.; Giesy, J.P. (Michigan State Univ., East Lansing (USA). Inst. of Water Research). 30 Jun 1986. 41p. NTIS, PC A03/MF A01.

The purpose of this research was to determine the dose-lethality relationship for eggs and fry from adult female rainbow trout, exposed, chronically to ecologically-relevant, waterborne concentrations of 2,3,7,8-tetrachloro dibenzo-p-dioxin (2,3,7,8-TCDD); determine the rate constants for uptake, disposition, and depuration tissue distribution and bioconcentration factor of 2,3,7,8-TCDD in adult rainbow trout; and to use this information in conjunction with the concentration of 2,3,7,8-TCDD in eggs of salmonid fishes from the Great Lakes; in a hazard assessment to determine the hazard of presently existing and potential future concentrations of 2,3,7,8-TCDD to salmonid fish reproduction.

35858 **(PB—87-177366/XAB) Uptake and depuration studies of PCDDs and PCDFSs in freshwater fish.** Kuehl, D.W.; Cook, P.M.; Batterman, A.R. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). 1986. 6p. (EPA—600/J-86/318). NTIS, PC A02/MF A01.

Pub. in Chemosphere, Vol. 15, No. 9-12, 2023-2026(Mar 1986).

The bioavailability of PCDD/PCDFs from municipal-incinerator fly ash and sediment to freshwater fish was studied. A preference to selectively bioaccumulate PCDD/PCDF isomers substituted in the 2,3,7, and 8 positions was observed. The depuration half life of 2,3,7,8-TCDD from carp was found to be 300-325 days. The rate of depuration of PCDD/PCDFs decreased with increasing degree of chlorination.

35859 **(PB—87-180790/XAB) Carcinogenic effects in A/J mice of particulate of a coal-tar paint used in potable water systems.** Robinson, M.; Laurie, R.D.; Bull, R.J.; Stober, J.A. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). 1987. 8p. (EPA—600/J-87/008). NTIS, PC A02/MF A01.

Pub. in Cancer Letters, Vol. 34, 49-54(1987).

Coal-tar paints are among the products used as inside coatings for water pipes and storage tanks to retard corrosion in potable water-supply systems. Four different formulations of these paints were tested in earlier work by this laboratory in the Ames mutagenesis and the mouse skin carcinogenesis bioassays(6). The paint most active in these assays was then tested in a particulate form in the lung adenoma assay with A/J mice. The paint was applied to clean glass plates, cured, collected and homogenized in 2% Emulphor. Doses of this coal-tar suspension were administered by gavage at 1.0, 10.0, and 55.0 mg in 0.2 ml per mouse 3 x weekly for 8 weeks. The total doses of coal-tar paint were 24, 240, and 1320 mg/mouse. Benzo(a)pyrene, administered in a parallel schedule to a total dose of 6 mg/mouse, served as positive control. A negative control group received an equivalent volume of 2% Emulphor. Animals were sacrificed at 9 months of age (8 months after first dose) and lung adenomas counted. A dose-related response, in the average number of lung tumors per mouse, was observed with the coal-tar particulate. There were also squamous-cell tumors of the forestomach in 42% of the mice receiving 55.0 mg coal tar paint per application.

35860 **(PB—87-181376/XAB) Cadmium: Position Document 1.** (Environmental Protection Agency, Washington, DC (USA). Office of Pesticide Programs). Oct 1977. 46p. (EPA—540/09-87/157). NTIS, PC A03/MF A01.

The Position Document addresses the risks and benefits of pesticide products containing the subject active ingredient. The Agency has determined that the use of products containing the subject active ingredient may meet or exceed a risk criterion described in 40 CFR Part 154. Potential hazards will be examined further to determine the nature and extent of the risk, and considering the benefits of the subject active ingredient, whether such risks cause unreasonable adverse effects on the environment.

35861 (TVA/ONRED/AWR—87/15, pp 7) **Integrated forest study on effects of atmospheric deposition.** Johnson, D.W.; Lindberg, S.E.; Bondietti, E.A.; Todd, D.E.; Owens, J.; Schaefer, D.A.; Harrison, R.B.; Silsbee, D. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

The Electric Power Research Institute (EPRI) acid deposition research program is based upon the recognition that forests are complex, long-lived systems, and that understanding how pollutants affect the health of forests will come only from long-term basic research on the mechanisms of action. The Integrated Forest Study on Effects of Atmospheric Deposition is one of EPRI's three large, integrated research projects designed to address the forest effects problem. The principal objective of this study is to evaluate the effects of atmospheric deposition on forest nutrient cycling. Specifically, processes regulating the mobility of sulfate, nitrate, hydrogen ions, base cations, and aluminum are being studied by monitoring the fluxes of these ions from atmosphere through various forest ecosystems, and by altering N, S, and H+ inputs in a series of manipulative studies.

35862 (TVA/ONRED/AWR—87/15, pp 21) **Forest decline survey of the southern Appalachian Mountains three-year analysis.** Bruck, R.I.; Robarge, W.P. (North Carolina State Univ., Raleigh). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.).

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

A third year of scientific investigation addressing the etiology and epidemiology of boreal montane forest decline in the southern Appalachian Mountains was completed in 1986. Analysis of the 1984 data indicated that the spruce-fir decline syndrome is observed in varying degrees throughout the sixe mountains studied (Mount Rogers, Roan Mountain, Grandfather Mountain, Mount Mitchell, Mount LeConte, and Clingmans Dome). West-facing slopes exhibited greatest decline and dieback incidence along with more pronounced radial increment suppression. The 1984 data also indicated that low altitude (below 5300 feet) red spruce were generally asymptomatic (exhibiting only 21% individuals in diseased decline classes). Observations made during the 1985 survey (same plots and trees) revealed a significant deterioration in tree condition. Only 49% of low altitude red spruce and 41% of high altitude individuals remained in the healthy disease class category. Individual tree mortality increased by 5% on all plots. During the spring of 1986, the same plots were again visited, and although the rate of deterioration was significantly lower than previously observed (1984-85), the trend towards tree decline and mortality continued. Seven percent of all red spruce were dead. The cause of the observed decline is not known. Data addressing climatic anomalies and correlation of atmospheric deposition patterns to high altitude ecosystems will be discussed.

35863 (TVA/ONRED/AWR—87/15, pp 48-49) **Biological effects of stream acidification in the Southern Appalachians.** Mulholland, P.J. (Oak Ridge National Lab., TN). Dec 1986. NTIS, PC A05/MF A01. File Number DE87900625. (CONF-8610263—Absts.). Contract AC05-84OR21400.

From 3. annual acid rain conference for the Southern Appalachians; Gatlinburg, TN, USA (27 Oct 1986).

An overview is presented of results of studies on the biological effects of stream acidification in the Southern Appalachians and a discussion of future research needs. Fish are generally absent in highly acidic streams (pH <5, monomeric aluminum concentrations >0.1 mg/L); however, these streams are confined to areas draining

exposed outcrops of the pyritic Anakeesta formation. Depressions of streams pH during storms from values >6 to values <5 have resulted in mortality of hatchery-raised rainbow trout. Laboratory and field assays have indicated that short-term (48 to 72 hours) exposure to both low pH (<6) and high concentrations of monomeric aluminum (0.1 mg/L) contribute to the increased mortality.

35864 **(UCRL—96831) Mutagenic heterocyclic imidazoamines in cooked foods.** Felton, J.S.; Knize, M.G.; Shen, N.H.; Wu, Rebekah; Becher, G. (Lawrence Livermore National Lab., CA (USA); Statens Inst. for Folkehelse, Oslo (Norway)). Jun 1987. Contract W-7405-ENG-48. 15p. (CONF-8704125—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011347.

From 3. international conference on carcinogenic and mutagenic N-substituted aryl compounds; Dearborn, MI, USA (25 Apr 1987).

Cooking ground beef at 300°C produces at least 8 distinct mutagens. All of these compounds fit into a general chemical class called aminoimidazoazaarenes (AIAs). Our studies suggest that most of this set of AIAs are present in cooked beef, pork, and chicken. Described in this manuscript are two new mutagens that appear to have oxygen atoms in the ring system. The amounts of these very potent bacterial mutagens vary from 20 ppB to <0.1 ppB depending on the mutagen, cooking conditions, and food tested. The production of these mutagens in food depends on the presence of creatine or creatinine and specific amino acids and cooking temperatures between 150 to 300°C for an appropriate period of time. In CHO (Chinese hamster ovary) cells, the relative potency of the compounds differed significantly from the bacterial responses. The risk from consuming these compounds is still very unclear because of their relatively low levels in our diet and the lack of consistency in the biological response data. 36 refs., 4 figs., 1 tab.

35865 **Ranking possible carcinogenic hazards.** Ames, B.N.; Magaw, R.; Gold, L.S. (Univ. of California, Berkeley). *Science (Washington, D.C.);* **236**: 271-280(17 Apr 1987).

This review discusses reasons why animal cancer tests cannot be used to predict absolute human risks. Such tests, however, may be used to indicate that some chemicals might be of greater concern than others. Possible hazards to humans from a variety of rodent carcinogens are ranked by an index that relates the potency of each carcinogen in rodents to the exposure in humans. This ranking suggests that carcinogenic hazards from current levels of pesticide residues or water pollution are likely to be of minimal concern relative to the background levels of natural substances, though one cannot say whether these natural exposures are likely to be of major or minor importance.

35866 **Deriving allowable daily intakes for systemic toxicants lacking chronic toxicity data.** Layton, D.W.; Mallon, B.J.; Rosenblatt, D.H.; Small, M.J. (Lawrence Livermore National Lab., CA). *Regulatory Toxicology and Pharmacology;* No. 1, 96-112(Mar 1987).

The lack of human toxicological data for most chemical compounds makes it difficult to quickly assess health risks associated with exposure to contaminants at hazardous waste sites. It would therefore be advantageous to have a technique for estimating acceptable daily intakes (ADIs) of potentially toxic substances based on more widely available animal toxicity data. This article focuses on the use of LD50 data to derive provisional ADIs, and it suggests multiplying oral LD50 values (expressed in mg/kg of body wt) by a factor in the range of 5 X 10(-6) to 1 X 10(-5) day-1 to convert them to such ADIs. It is emphasized that these interim ADI values are no substitute for toxicity testing, but that such testing would most likely result in higher ADI estimates.

35867 **Assimilate utilization in the leaf canopy and whole-plant growth of soybean during acclimation to elevated CO_2.** Cure, J.D.; Rufty, T.W. Jr.; Israel, D.W. (Duke Univ., NC). *Botanical Gazette (Chicago);* **148**: No. 1, vp(Mar 1987). Contract FG05-85ER60373.

Young vegetative soybeans (Glycine max Ransom) were exposed to control (350 $^{+}$L L^{-1} CO_2) or CO/sub 2-/ enriched (700 μL L^{-1} CO_2) environments continuously for 22 days. Alterations in carbon acquisition, assimilate utilization by the leaf canopy, and whole plant-growth were followed to characterize plant acclimation at high CO_2. Whole-plant dry weight (DW) progressively increased at high CO_2 relative to the control throughout the experiment. The initial DW increases were associated with the accumulation of nonstructural assimilates in leaves and increased specific leaf weight (SLW). After 3 days, however, DW began to accumulate rapidly in stems and roots under high CO_2, and SLW no longer increased relative to controls. Total leaf area did not increase significantly at high CO_2 until 13 days after the start of treatment. Net assimilation rates declined under both CO_2 conditions but remained higher at 700 μL L^{-1} CO_2 throughout the experiment. The increases in stem and root DW during week 1 at high CO_2 were accompanied by an early increase in the stimulated rate of assimilate utilization in the canopy during the dark phase of the diurnal cycle and a later increase in the estimated rate of assimilate utilization during the light phase. The results indicate that dark mobilization of assimilates from source leaves responded to variations in assimilate accumulation but that export of assimilates from source leaves in the light adjusted more slowly and appeared to be coordinated with large changes in sink activity in the whole plant.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 35385

35868 **(AD-A—177924/8/XAB) Microwave radiation effects on the thermally driven oxidase of erythrocytes.** Keil, J.L.; Erwin, D.N. (School of Aerospace Medicine, Brooks AFB, TX (USA)). 1986. 15p. (USAFSAM-TR—85-63). NTIS, PC A02/MF A01.

Pub. in International Jnl. of Hyperthermia, Vol. 2, No. 2, 201-212(1986).

Sheep red blood cells (SRBCs) were labelled with a concanavalin A-luminol-bovine serum albumin conjugate specific for the transmembrane anion transport protein (Band 3) and exposed to 2450-MHz continuous-wave microwave radiation at an average specific absorption rate of 91W/kg for 10 min. The temperature was held constant at 25, 37, 40, 42, or 45C with an airflow heat-exchange system. Following exposure to microwave or air heating, the decrease in residual base-activated chemiluminescence (CL) of the SRBCs was measured as an indication of infield oxidase activity. Air heating resulted in a significant decrease in residual CL at temperatures above 37C (74% decrease at 45C). Microwave radiation inhibited the decline in residual CL above 37C. At 45C the inhibition was 40%. The results suggest microwave radiation either reversibly altered the thermodynamics of oxygen binding to haemoglobin or failed to energize a significant portion of the haemoglobin molecules in each sample to the thermal threshold of haemoglobin autoxidation.

35869 **(AD-A—178054/3/XAB) Sequential morphologic alterations in the foveola and cornea of nonhuman subjects after exposure to coherent light. Annual report, March-September 1985. Final report, October 1979-September 1985.** Spencer, W.H. (Pacific Medical Center, San Francisco, CA (USA)). Sep 1985. 57p. NTIS MF A01.

Availability: Microfiche copies only.

This is an investigation of the sequential (one hour, one day, one week, one month) clinical and morphologic (light and electron microscopic) effects upon the foveolar and parafoveolar retina of single short-duration pulses of coherent light at 694.3 nm and 532 nm at total intraocular energy levels of approximately three times ed50. Focal injury to the retina and subjacent choroid is found to be less marked at 532 nm than at 694.3 nm. The lesions are sharply circumscribed and primarily involve the outer layers of the retina and the retinal pigment epithelium. Lesser damage occurs in the inner retina and in the choroid. Morphologic evidence of healing is noted within one hour and progresses almost to completion within one month. The process involves a combination of phagocytosis, cellular migration, and possibly cellular proliferation. Inflammatory cell infiltration and scarring is not observed.

35870 (AD-A—178182/2/XAB) Scaling of three microwave exposure systems on the basis of averaged whole-body specific absorption rate. Final report, 1 June 1983-1 June 1986. O'Connor, M.E. (Tulsa Univ., OK (USA). Dept. of Psychology). 6 Feb 1987. 39p. NTIS, PC A03/MF A01.

Three systems for exposing small laboratory animals to 2450-MHz microwave radiation were compared using whole-body averaged specific absorption rate (SAR). The three systems were a plane wave propogated in an anechoic chamber, a circularly polarized waveguide, and a multimode cavity. Following calibration of the three systems, a temperature-profile study assessing brain and colonic temperature in rat carcasses was performed. A third study investigated seizures in young mouse pups. There were statistically significant differences between the three systems regarding heat distribution as indicated by brain and colonic temperatures. Exposure in the circularly polarized waveguide resulted in lower temperatures at both sites. However, when young mouse pups were placed in the chambers and exposed at levels calculated to produce whole-body averaged SARs of 90 W/kg, the seizures produced by the plane wave exposures required nearly twice the amount of time as those in the waveguide or multimode cavity. The results suggest that average whole-body SAR should not be used for making comparisons of effects obtained in different exposure systems.

35871 (AD-A—178427/1/XAB) Biological applications and effects of optical masers. Annual report, 16 March 1984-15 March 1985. Ham, W.T.; Mueller, H.A.; Ruffolo, J.J.; Cleary, S.F.; Guerry, R.K. (Medical Coll. of Virginia, Richmond (USA)). Sep 1985. 23p. NTIS, PC A02/MF A01.

Histological studies on the right eye of a monkey exposed three and one half years ago to the Miles prototype GaAs laser confirm the visual acuity tests performed on this animal. There was no histological evidence of retinal damage. The aphakic eye of a monkey exposed to near-uv radiation under high blood-oxygen tension was examined. There was widespread cone destruction and extensive damage to the RPE at radiant exposures well below the threshold for monkeys under normal oxygenation conditions. Very small lesions produced in the monkey macula by 40-microsecond pulses of 647 nm argon-krypton laser light at 1600 pulses per second were examined. The effects of the intravenous injection of superoxide dismutase (SOD), catalase, and SOD + catalase on the blue-light retinal lesion, inflicted both before and after injection, were studied by in vivo observation. The threshold for photic damage to the retina for a period of two years. Threshold data on argon-krypton laser pulse trains at two wavelengths have been obtained for pulse repetition frequencies and exposure times. Trained rhesus monkeys exposed to 5mW/sq cm of a near-uv continuous spectrum on a daily basis showed no lenticular changes between exposed and control eye when examined biomicroscopically.

35872 (DOE/SR—8002) Investigation report: Toxic gas release from the beta-gamma incinerator at the Savannah River Plant on December 9, 1986. (USDOE Savannah River Operations Office, Aiken, SC). 17 Feb 1987. 65p. NTIS, PC A04. File Number DE87010911.

On December 9, 1986, a scheduled functional test of the Halon fire suppression system in the Feed Lag Storage Area (FLA) of the BGI facility was initiated by manually activating the Halon system. Interlocks that shutdown ventilation in the FLA operated as designed, and the 756-lb charge of Halon 1301 was released into the FLA as intended. Normal building air flow designed to minimize spread of contamination, plus a momentary increase in pressure in the FLA resulting from the discharge of Halon, caused an estimated 450 lb of Halon to enter the adjacent process room through a number of small openings in the sheetmetal separating wall. About 240 lb of the Halon was drawn into the incinerator where it thermally decomposed into hydrogen fluoride and bromine. These gases were discharged through the incinerator stack. About 10:20 a.m., some employees, working approximately 1500 ft downwind, began to experience eye and respiratory irritation. An orange-yellow plume was observed to be coming from the BGI stack. At 10:28 a.m., S-Area supervision initiated an S-Area evacuation and notified plant management of the situation. At 10:33 a.m., the Halon test in the BGI was terminated and the FLA was opened and allowed to ventilate. At 10:50 a.m., it was determined that Halon decomposition in the BGI was the source of the irritating fumes and the incinerator was immediately shutdown. Approximately 10 S-Area Construction employees received first aid for respiratory irritation, and four were sent to an area hospital for evaluation. 9 figs.

35873 (PB—87-162848/XAB) Walk-through survey report on rf radiation exposures from heat sealers at Chrysler Trim Plant, Lyons, Michigan. Herrick, R.F.; Robinson, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). 16 Aug 1979. 17p. (IWS—88.22A). NTIS, PC A02/MF A01.

See also PB—83-104752.

Worker exposures to radiofrequency (RF) radiation were determined at the Chrysler Trim Facility. The company was under consideration for inclusion in a NIOSH study of the health effects of occupational RF exposure. Approximately 76 of the employees at the facility were assigned to the heat-sealing operations that were surveyed. The company had a formal safety and industrial-hygiene program. Personnel records provided demographic information, department assignments, and absence reports. One of the five heat-sealing presses tested exceeded existing electric-field-strength guidelines of 200 volts per meter. The authors conclude that the personnel records at the facility are adequate for conducting a reproductive history or mortality study of workers employed in the heat-sealing area, although the general low worker exposures to RF radiation makes the facility unsuitable for inclusion in the RF radiation-hazard study. They recommend that shields be added to the heat-sealing presses to reduce worker exposures to RF radiation.

35874 (PB—87-164190/XAB) Industrial-hygiene walk-through survey report on rf radiation exposures from heat sealers at Fabrico Manufacturing Corporation, Chicago, Illinois. Herrick, R.F.; Robinson, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Industrial Hygiene Section). 4 Sep 1979. 21p. NTIS, PC A02/MF A01.

The intensity of electric and magnetic fields generated by heat-sealing presses was measured during a NIOSH walk-through survey on April 6, 1979, at the Fabrico Manufacturing Corporation, Chicago, Illinois. Fabrico employed approximately 55 heat-sealer operators at the time of the survey. Fabrico's heat-sealing presses use radiofrequency (RF) radiation to heat and seal a variety of plastic products. The surveyors corrected the magnetic-field intensities of the presses for duty cycle to determine press operators' exposure while presses were operating. Electric and magnetic field measurements using a broad-band isotropic radiation monitor revealed that guidelines for electric and magnetic fields were exceeded on four of eight heat sealing machines. Although a proven hazard was not documented, the authors suggest that a resonant heating of the body could occur at frequencies above the guidelines and recommend the addition of shielding to the heat-sealing machines to reduce employee exposure. They also suggest that the cohort at Fabrico is not large enough for a health-effects study, but future visits to other facilities that fit the criteria may provide a suitable study group.

35875 (PB—87-164489/XAB) Walk-through survey report on radiation exposures from heat sealers at Georgia-Pacific Corporation, St. Louis, Missouri. Cox, C.; Murray, B.; Robinson, C. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Apr 1987. 17p. NTIS, PC A02/MF A01.

Workers at the Georgia-Pacific Corporation in St. Louis, Missouri, were evaluated for inclusion in a cohort study of the reproductive effects of radiofrequency (RF) radiation exposure. The intensity of the electrical and magnetic fields generated by several RF heat sealers were measured; both field levels were below the current recommended limits of 200 volts per meter and 0.5 amperes per meter, respectively. Examination of personnel records identified a small potential study cohort of workers employed in the RF heat-sealing area, along with an appropriate control group. The authors conclude that this cohort of workers is not large enough for a reproductive health effects study. They recommend that these workers be combined with similar cohorts from other RF facilities to provide a sufficiently large study group.

35876 **(PB—87-170056/XAB) Investigation of microwave and radiofrequency radiation levels in Vernon Township, New Jersey, November 10-15, 1985.** (Office of Radiation Programs, Las Vegas, NV (USA)). Jun 1986. 276p. NTIS, PC A13/MF A01.

At the request of the New Jersey Department of Environmental Protection, the U.S. Environmental Protection Agency (EPA) investigated microwave levels in Vernon Township, New Jersey. Vernon is the site of three satellite earth stations which operate a total of over 15 uplink antennas. Each of the three earth-station facilities was surveyed with broadband equipment, and frequency-specific data were collected at twenty-five sites in the surrounding communities. EPA gathered data in satellite uplink, terrestrial microwave, and broadcast-band frequencies. The highest power density found in any publicly accessible area in Vernon was 60 microwatts/sq cm on the property of one of the earth stations. The highest peak-power density found at any of the community measurement locations was approximately 0.003 microwatts/sq cm, in a frequency band that is not used for satellite uplink transmissions. Typical power density values over all the frequency bands studied are well below 0.001 microwatts/sq cm.

57 Health And Safety

REFER ALSO TO CITATION(S) 35826, 35854

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 34644

35877 **(DP-MS—86-180) Age and correlation of subsurface calcareous strata in the western South Carolina Coastal Plain.** Price, V.; Laws, R.A.; Zullo, V.A. (Savannah River Lab., Aiken, SC (USA); North Carolina Univ., Wilmington (USA). Dept. of Earth Sciences). 1987. Contract AC09-76SR00001. 29p. (CONF-8703125—1-Abst.). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010171.

From Geological Society of America - Southeastern section meeting; Norfolk, VA, USA (26 Mar 1987).

Megafossils and calcareous nannofossils from subsurface calcareous strata penetrated in 38 boreholes in the western South Carolina Coastal Plain permit correlation with the Gulf Coast Eocene Claibornian and Jacksonian stages, and with outcropping strata in adjacent regions. Reticulofenestra bisecta, R. umbilica, R. reticulata, C. formosus, Z. bijugatus, C. pelagicus, D. barbadiensis, and D. nodifer, are common and range throughout these strata. Other less common and stratigraphically restricted species present in these strata include D. distinctus, H. reticulata, H. seminulum, H. compacta, H. bramlettei, Chiasmolithus titus, C. solitus, and Campylosphaera dela. Nannofossils indicate ages no older than NP 16 and no younger than NP 19/20 (Upper Claibornian-Upper Jacksonian). Megafossils including Himerometra bassleri, Aporolepus howei, Arcoscalpellum jacksonense, and Kathpalmeria georgiana from the upper part of the unit indicate a Jacksonian age. The lower part contains Cubitostrea sellaeformis and "Solidobalanus" n. sp. characteristic of the Upper Claibornian. These calcareous strata correlate to the McBean and Dry Branch Formations of eastern Georgia, and to the Santee and Cross Formations of central South Carolina.

35878 **(DP-MS—86-181) Detailed geologic studies establish permeability trends for plume definition and ground-water clean-up.** Price, V.; Fallaw, W.C. (Savannah River Lab., Aiken, SC (USA); Furman Univ., Greenville, SC (USA)). 1986. Contract AC09-76SR00001. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010197.

Heterogeneity is the hallmark of near shore (fluvial to marginal marine) depositional sequences. Because of this, simple geologic models derived from cursory sampling or the more basic electric logs may not define permeability trends adequately for plume definition and contaminant mitigation efforts. A study area in the upper Atlantic Coastal Plain of South Carolina is discussed. Preliminary geologic and hydrologic data were incorporated into a three-dimensional flow model which predicted piezometric contours at right angles to observed contours. In addition, contaminated ground water was observed in locations that were considered to be upgradient of known sources based on preliminary assessment of piezometric data from a few early monitoring wells. Installation of later monitoring wells was accompanied by thorough and careful geologic sampling and collection of digitally-captured geophysical log data. Isopach and structure contour maps were constructed for significant high and low permeability strata. Probable middle Eocene erosion resulted in replacement of clays in an important aquitard with permeable channel sands over a small part of the study area. Discovery of breaches in the confining layers permitted observed patterns of contaminant distribution and piezometric data to be explained.

35879 **(RISO-M—2614) Survey of archaeological samples dated in 1985.** Mejdahl, V. (Risoe National Lab., Roskilde (Denmark)). Nov 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752179.

A survey is given of archaeological samples received for dating in 1985 at the Nordic Laboratory for Thermoluminescence Dating. A total of 66 samples were dated, 42 of which were burnt stones. All results were corrected for short- term fading as measured for samples stored at room temperature for four weeks. The beta dose from potassium and rubidium in feldspar and the alpha dose from uranium and thorium in quarts and feldspar were included assuming alpha efficiency factors of 0.1 for quartz and 0.2 for feldspar. 30 refs.

35880 **(SAND—86-2311) Analysis of pumping tests of the Culebra Dolomite conducted at the H-3 hydropad at the Waste Isolation Pilot Plant (WIPP) site.** Beauheim, R.L. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1987. Contract AC04-76DP00789. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. File Number DE87008892.

Two pumping tests were conducted in the Culebra Dolomite Member of the Rustler Formation at the H-3 hydropad at the Waste Isolation Pilot Plant (WIPP) site. The first test was in 1984, with well H-3b3 pumped for 14 days at an average rate of 4 gpm. The second test, the H-3 multipad test, was in late 1985 and early 1986, with well H-3b2 pumped for 62 days at an average rate of 4.8 gpm. Both tests provided information on the hydraulic properties of the Culebra at the H-3 hydropad. The second test provided information on average Culebra hydraulic properties on a much larger scale, responses were observed up to 8000 ft from the pumping well. The interpretation of these tests had three principal objectives. The first was to determine the most appropriate conceptualization of the nature of the Culebra flow system around the H-3 hydropad. The pumping well responses during the H-3 tests appear to be those of wells completed in a double-porosity medium with unrestricted interporosity flow. In such a system, fractures provide the bulk of the permeability, while matrix pores provide the majority of the storage capacity. The second objective was to quantify the hydraulic properties of the Culebra in the vicinity of the H-3 hydropad. The third objective was to quantify the average hydraulic properties of the Culebra between the H-3 hydropad and more-distant observation wells. Meeting this objective was complicated by the effects of an apparent increase in groundwater leakage from the Culebra into the Waste-Handling Shaft on the data from wells near that shaft, and by water-level/pressure trends already existing at many of the observation wells when the multipad test began.

35881 **(UCID—21084) High resolution data base for use with MAP.** Tapley, W.C.; Harris, D.B. (Lawrence Livermore National Lab., CA (USA)). 5 May 1987. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011601.

A high resolution cartographic data base of thw World is available from the CIA. We obtained this data, extracted portions of the data, and produced cartographic files of varying resolutions. The resulting data files are of the proper format for use with MAP [2], our in-house cartographic plotting program.

35882 **(USGS/MAP/MF—1824) Trench logs from a strand of the Rock Valley Fault System, Nevada Test Site, Nye County, Nevada.** Yount, J.C.; Shroba, R.R.; McMasters, C.R.; Huckins, H.E.; Rodriguez, E.A. (Geological Survey, Reston, VA (USA)). 1987. Contract AI08-78ET44802. 49p. US Geological Survey - Open File Service, Box 25425 - Denver Federal Center, Denver, CO 80225. File Number TI87009732.

The Rock Valley fault system trends northeasterly through the southeast corner of the Nevada Test Site. The system records left-lateral offset of Paleozoic and Tertiary rocks, although total offset amounts to only a few kilometers. Distinct scarps in alluvial deposits of Quaternary age and a concentration of seismicity, particularly at its north end, suggest that the Rock Valley fault system may be active. Two trenches were excavated by backhoe in 1978 across a 0.5-m-high scarp produced by a strand of the Rock Valley fault system. A detailed logging of the two Rock Valley fault trenches was undertaken during the spring of 1984. This report presents: (1) logs of both walls of the two trenches, (2) a general description of the lithologic units and the soils formed in these units that are exposed in and near the fault trenches, (3) observations of the clast fabric of unfaulted and faulted deposits exposed in the trench walls, and (4) a map of the surficial deposits in the vicinity of the trenches.

35883 **Calcium-41 concentration in terrestrial materials: prospects for dating of pleistocene samples.** Henning, W.; Bell, W.A.; Billquist, P.J.; Glagola, B.G.; Kutschera, W.; Liu, Z.; Lucas, H.F.; Paul, M.; Rehm, K.E.; Yntema, J.L. (Argonne National Lab., IL). *Science (Washington, D.C.);* **236**: 725-727(8 May 1987). Contract W-31-109-ENG-38.

Calcium-41 bas been suggested as a new tool for radiometric dating in the range of 10^5 to 10^6 years. The concentration of cosmogenic calcium-41 in natural samples of terrestrial origin has now been determined by high-sensitivity accelerator mass spectrometry after pre-enrichment in calcium-41 with an isotope separator. Ratios of calcium-41 to total calcium between 2×10^{-14} and 3×10^{-15} were measured for samples of contemporary bovine bone and from limestone deposits. Some prospects for the use of calcium-41 for dating Middle and Late Pleistocene bone and for other geophysical applications are discussed.

5802 Geophysics

REFER ALSO TO CITATION(S) 34644, 34960, 34961, 35553

35884 **(AD-A—178251/5/XAB) Norwegian seismic array (NORSAR). Semiannual technical summary, 1 April-30 September 1986 on Phase 3.** Loughran, L.B. (Royal Norwegian Council for Scientific and Industrial Research, Kjeller). Nov 1986. 125p. (NORSAR-SCIENTIFIC—1-86/87). NTIS, PC A06/MF A01.

This Semiannual Technical Summary describes the operation, maintenance and research activities at the Norwegian Seismic Array (NORSAR) for the period 1 Apr - 30 Sep 1986. The uptime of the NORSAR online detection processor system has averaged 99.3% during the reporting period. The array communications system has generally shown a reliable performance. A total of 2218 seismic events were reported in the NORSAR monthly seismic bulletins in this period. It was found worthwhile to implement full 20-Hz processing NORSAR data, which will involve installing 8-Hz analog filters, new detection processor coding and new event processor coding. Field-maintenance activity included regular preventive maintenance at all subarrays and occasional corrective actions as required. No special problems were noted in the performance of the field installations. In addition, field maintenance personnel have participated in experiments involving the High Frequency Seismic Element (together with Sandia representative), as well as noise measurements and reconnaissance for selecting a site for a possible new small array.

35885 **(DOE/ER/10401—6) Thermal regimes of major volcanic centers: Magnetotelluric constraints on the coupling of deep-seated magma genesis to high-level geothermal reservoirs: Summary of research accomplishments, 1980-1986: Final technical report.** Hermance, J.F. (Brown Univ., Providence, RI (USA). Dept. of Geological Sciences). 1986. Contract AC02-79ER10401. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010581.

The report summarizes the status of progress in a program designed to apply geophysical techniques to detecting and characterizing geological features and physical processes within the earth that are related to energy resources. Attention was directed toward acquiring an understanding of dynamical processes and thermal regimes associated with centers of major volcanic activity, emphasizing studies of the Long Valley/Mono Basin volcanic complex. (ACR)

35886 (NP—7752440, pp 22-23) **Follow-up of aero-geophysical and soil-geophysical anomalies in the region ranging from Karlspitz to Donnersbachtal-Hochgroessen.** Mauritsch, H.J. (Forschungsgesellschaft Joanneum, Graz, Austria. Inst. fuer Geophysik). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The report on hand covers geophysical measurements performed on the Eastern greywacke zone in the Pruggern-Donnersbach region. Evaluation was effected by means of single profile demonstration and in an integrative evaluation of all methods in correlation to geographical mapping.

35887 **(NUREG/CR—3145-Vol.5) Geophysical investigations of the Western Ohio-Indiana region: Final report, October 1981-September 1986.** Christensen, D.H.; Pollack, H.N.; Lay, T.; Schwartz, S.Y. (Michigan Univ., Ann Arbor (USA). Dept. of Geological Sciences; Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Safety). Mar 1987. 73p. NTIS, PC E06/MF A01 - GPO. File Number TI87900772.

Includes 6 sheets of 24x reduction microfiche.

Earthquake activity in the Western Ohio-Indiana region has been monitored with a precision seismograph network consisting of nine stations located in west-central Ohio and four stations located in Indiana. Five local and near-regional earthquakes have been recorded and located during the 1985-86 fiscal report period, ranging in magnitude from 0.5 to 5.0m/sub b/. The two largest of these events (January 31, 1986, near Cleveland, Ohio, magnitude = 5.0m/sub b/, and July 12, 1986, near St. Marys, Ohio, magnitude = 4.5m/sub b/) were felt with minor damage reported in each case. Focal mechanisms and isoseismal maps for these events are included in this report. These events are the largest to have occurred in Ohio since the events of March 2 and March 9, 1937 (magnitude = 4.5 and 4.9, respectively). The remaining three earthquakes of this report period all occurred in Ohio, north of the array. A total of 42 local and near-regional events, eleven of which have been felt, have now been recorded by the Ohio-Indiana array since its initiation in 1976. Teleseismic P-wave arrival and residual tables have been updated to include newly acquired data. The results are similar to those in previous years. The local velocity structure has been investigated using data acquired during a refraction experiment in the summer of 1984 and travel time data of local and near regional earthquakes.

35888 **(SAND—87-0748C) Application of nodal S/sub N/ methods to radiation transport in nuclear well logging.** Badruzzaman, A.; Chiaramonte, J. (Schlumberger-Doll Research Center, Ridgefield, CT (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-870424—12). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007681.

From American Nuclear Society international meeting on advances in reactor physics, mathematics and computation; Paris, France (27 Apr 1987).

Results of testing a three-dimensional nodal discrete method on problems of interest in well logging are presented. Tests on an

(x-y-z) benchmark logging problem show that the linear surface nodal method performs significantly better than the conventional linear diamond scheme. For the problems studied, the nodal method requires ten-fold less mesh and two-fold fewer discrete directions than the linear diamond method. The latter method also exhibits a large sensitivity to the number of discrete directions used. Tests on an actual eccentered, cylindrical geometry logging problem show that the rectangular geometry approximation of the (x-y-z) nodal method can be used to adequately represent the curved bondaries of the problem.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 34653, 34791

35889 **(CONF-8609287—Vol.1) European conference on numerical methods in geomechanics (ECONMIG 86). Proceedings. Vol. 1. National reports.** (Stuttgart Univ. (Germany, F.R.)). 1986. 183p. NTIS (US Sales Only), PC A09. File Number DE87752435.

From ECONMIG 86: European conference on numerical methods in geomechanics; Stuttgart, F.R. Germany (16 Sep 1986).

Volume 1 of the conference report reviews the national activities of Belgium, Czechoslovakia, France, West Germany, Italy, the Netherlands, Portugal, Spain, Switzerland, and Great Britain in the modelling of geomechanical phenomena.

35890 **(DOE/ER/13096—2) Energetics and thermochemical properties of rocks and minerals: Final report for period July 16, 1984-October 15, 1986.** Thompson, J.B. Jr.; Dobos, S.K. (Harvard Univ., Cambridge, MA (USA)). Jun 1987. Contract AC02-83ER13096. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011201.

The effort of this research was the design, construction and calibration of a modern instrumental calorimetry lab equipped for thermochemical measurements of earth materials in the temperature range -170 to +1700°C. Two calorimeters and a thermogravimetric unit have been installed; to ensure maximum precision and accuracy, the instruments are environmentally, mechanically and electrically isolated, and are operated in controlled atmospheres in a specially constructed calorimetry lab. A theoretical study of the energetics of short-range order in aluminous pyroxenes demonstrates the preference of unlike-valence cation pairs, and that the configurational entropy may be described with a mutably constrained random model. Work has commenced on the measurement of the energetics and kinetics of devolatilization of hydrous rock-forming minerals, chiefly cordierite, as well as the energetics of anhydrous minerals.

35891 **(NP—7752440) Energy and raw materials research activities. Report by the Steiermark Government.** (Amt der Steiermaerkischen Landesregierung, Graz (Austria). Abt. fuer Wissenschaft und Forschung). Oct 1986. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

This volume contains the results of research into energy and raw materials. Raw materials research covers mainly the fields of geology, petrography and mineralogy, whereas energy research focusses on renewable energy sources like biogas and wood, and presents results of research into nuclear fusion. 16 papers were entered separately.

35892 (NP—7752440, pp 24-25) **Lithological collection of the Institute for Geology, Petrography and Mineralogy of the Graz Technical University.** Zirkl, E.J. Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

Collections of small-sized rock samples (up to some 10 by 15 cm) are relatively easy to acquire and to accomodate but are less suitable for demonstration, especially if coarse-grained and coarse-textured rocks are concerned. That is why the institute began to set up a collection of large-sized rock samples. More than 20 years of collecting allowed to accumulate some 2,000 rock plates which are of an identical size (20 by 30 cm) and most of which have been polished on one face. The collection ('Lithothek') in the Graz Technical University is available to everybody free of charge. Visitors are requested to turn to the author for a visit during normal working hours.

35893 **(SAND—86-1131) Petrologic and mechanical properties of outcrop samples of the welded, devitrified Topopah Spring Member of the Paintbrush Tuff.** Price, R.H.; Connolly, J.R.; Keil, K. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Geology). May 1987. Contract AC04-76DP00789. 78p. NTIS, PC A05/MF A01; GPO Dep. File Number DE87010524.

More than fifty outcrop samples of the Topopah Spring Member of the Paintbrush Tuff have been analyzed for their petrologic or mechanical properties. In general, the compositions of these samples are very similar to each other and to stratigraphically equivalent samples from drill holes within Yucca Mountain. There are, however, specific textural features that are locally variable and a nonuniform distribution of high porosity textural features throughout Yucca Mountain. The mechanical test samples all had nominal diameters of 50.8 mm and a nominal length-to-diameter ratio of 2:1. Both fully saturated and oven dried samples were deformed in compression at effective confining pressures of 0, 5 and 10 MPa; temperatures of 22 and 150°C; and nominal strain rates of 10^{-7}, 10^{-5}, and 10^{-3} s^{-1}. Bulk modulus is directly related to both saturation and pressure, Young's modulus is inversely related to temperature, and ultimate strength is directly related to pressure and inversely related to temperature. All of these effects, however, are secondary to the elastic and strength property variability resulting from inclusion of highly porous inhomogeneities. 32 refs., 15 figs., 7 tabs.

35894 **(SAND—86-2085) Complex load response of a dry, highly porous tuff.** Butcher, B.M.; Jones, A.K. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1987. Contract AC04-76DP00789. 48p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87010624.

Results from an experimental study to define the mechanical properties of a highly porous (42% porosity) tuff are described in this paper. The property requirements were defined by a model for compaction of wet porous solids, recently proposed by Drumheller, which shows that prediction of wet rock response requires characterization of the elastic constants and inelastic deformation of the same rock in the dry condition. A secondary objective in fulfilling this requirement was to characterize the material with as few tests as possible by increasing the complexity of the test methods. The principal result from the investigation was development of a functional relationship between values for the elastic constants and the porosity. This correlation defines the change in elastic constants with inelastic compaction, for wave propagation analysis, and can also be used to estimate elastic properties of tuffs with different initial porosity values. Our ability to relate stress induced changes to unstressed states with different porosity values is new. Elastic constant values for various states of compaction can now be estimated for a mineralogically similar porous rock with a different initial porosity. Our new approach requires an absolute minimum of laboratory results, thus reducing the need for a large, costly testing program. Analysis of the inelastic parts of the compaction tests confirmed the applicability of mathematical forms used by Drumheller to describe hydrostatic loading and unloading. A strong relationship between shearing and work hardening during compaction was also observed, that made increases in deviatoric stresses highly dependent on the loading history of the rock.

35895 **Rare earth patterns in shergottite phosphates and residues.** Laul, J.C. (Chemical Sciences Department, Battelle, Pacific Northwest Laboratories, Richland, Washington). *Journal of Geophysical Research;* **92**: No. B4, 633-640(30 Mar 1987).

Leaching experiments with 1M HCl on ALHA 77005 power show that rare earth elements (REE) are concentrated in accessory phosphate phases (whitlockite, apatite) that govern the REE pat-

terns of bulk shergottites. The REE patterns of whitlockite are typically light REE depleted with a negative Eu anomaly and show a hump at the heavy REE side, while the REE pattern of apatite (in Shergotty) is light REE enriched. Parent magmas are calculated from the model compositions of residues of ALHA 77005, Shergotty, and EETA 79001. The parent magmas lack a Eu anomaly, indicating that plagioclase was a late-stage crystallizing phase and it probably crystallized before the phosphates. The parent magmas of ALHA 77005 and Shergotty have similar REE patterns with a subchondritic Nd/Sm ratio. However, the Sm/Nd isotopics require a light REE depleted source for ALHA 77005 (if the crystallization age is <600 m.y.) and a light REE enriched source for Shergotty. Distinct Nd and Sr isotopic signatures may suggest different source regions for shergottites. copyright American Geophysical Union 1987

5804 Geochemistry

35896 **(GJBX—1(85)-Vol.1) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Introduction to Data Files, United States: Volume 1.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 184p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014039.

One product of the Hydrogeochemical and Stream Sediment Reconnaissance (HSSR) program, a component of the National Uranium Resource Evaluation (NURE), is a data-base of interest to scientists and professionals in the academic, business, industrial, and governmental communities. This database contains individual records for water and sediment samples taken during the reconnaissance survey of the entire United States, excluding Hawaii. The purpose of this report is to describe the NURE HSSR data by highlighting its key characteristics and providing user guides to the data. A companion report, "A Technical History of the NURE HSSR Program," summarizes those aspects of the HSSR Program which are likely to be important in helping users understand the database. Each record on the database contains varying information on general field or site characteristics and analytical results for elemental concentrations in the sample; the database is potentially valuable for describing the geochemistry of specified locations and addressing issues or questions in other areas such as water quality, geoexploration, and hydrologic studies. This report is organized in twelve volumes. This first volume presents a brief history of the NURE HSSR program, a description of the data files produced by ISP, a Users' Dictionary for the Analysis File and graphs showing the distribution of elemental concentrations for sediments at the US level. Volumes 2 through 12 are comprised of Data Summary Tables displaying the percentile distribution of the elemental concentrations on the file. Volume 2 contains data for the individual states. Volumes 3 through 12 contain data for the 1^0 x 2^0 quadrangles, organized into eleven regional files; the data for the two regional files for Alaska (North and South) are bound together as Volume 12.

35897 **(GJBX—1(85)-Vol.2) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Data Summary Tables, United States: Volume 2.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 212p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014038.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across states. Hawaii is missing from all tables since no sampling was done in that state. The following section briefly outlines the approach used by ISP in preparing these data tables. The third section contains the summary tables organized by sample type (water and sediment) and displaying elements within states and states within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35898 **(GJBX—1(85)-Vol.3) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, North East Region: Volume 3.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 176p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014037.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the North East Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the North East Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35899 **(GJBX—1(85)-Vol.4) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, East Region: Volume 4.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 190p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014036.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the East Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the East Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35900 **(GJBX—1(85)-Vol.5) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, South East Region: Volume 5.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 257p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014035.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the South East Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the South East Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35901 **(GJBX—1(85)-Vol.6) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, Mid East Region: Volume 6.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 249p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014034.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the Mid East Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the Mid East Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35902 **(GJBX—1(85)-Vol.7) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, North Region: Volume 7.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 191p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014033.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the North Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the North Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35903 **(GJBX—1(85)-Vol.8) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, Mid West Region: Volume 8.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 187p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014032.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the Mid West Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the Mid West Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35904 **(GJBX—1(85)-Vol.9) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, South West Region: Volume 9.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 216p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014031.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the South West Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the South West Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35905 **(GJBX—1(85)-Vol.10) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, West Region: Volume 10.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 210p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014030.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the West Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the West Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35906 **(GJBX—1(85)-Vol.11) NURE [National Uranium Resource Evaluation] HSSR [Hydrogeochemical and Stream Sediment Reconnaissance] Quadrangle Summary Tables, North West Region: Volume 11.** (Oklahoma Univ., Norman (USA). Energy Resources Inst.; Bendix Field Engineering Corp., Grand Junction, CO (USA). Grand Junction Operations). 4 Jun 1985. Contract AC07-82GJ01706. 154p. Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes: $80.00 per tape). File Number TI85014029.

This volume presents a summary of the distribution of elemental concentrations for water and sediment samples across quadrangles located in the North West Regional File. The next section briefly outlines the approach used by ISP in preparing these data tables. This is followed by an Alphabetical Index to the quadrangles contained in the North West Regional File and a Quadrangle Map; both the Index and Map present a record count for each quadrangle. The last section presents the data summary tables organized by sample type (water or sediments) and displaying elements within quads and quads within elements. These data summary tables show the general ranges of values present in the NURE Hydrogeochemical and Stream Sediment Reconnaissance sample data in each quadrangle or state. As with all summaries, they represent the data according to the best judgement of the professionals doing the analysis. This section gives a general description of the procedures used to produce the quadrangle summary percentiles.

35907 (NP—7752440, pp 3-16) **Regional basic survey of the geochemistry of the territory of the Federal Republic of Austria: Primary evaluation of the Lower Tauern Mountain range Crystalline, Eastern Greywacke Zone, and Gurktal Alps.** Wolfbauer, J. (Forschungsgesellschaft Joanneum, Graz, Austria. Sektion Rohstofforschung). Oct 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. File Number DE87752440.

Steirische Beitraege zur Rohstoff- und Energieforschung. No. 6.

In Energy and raw materials research activities. Report by the Steiermark Government.

The primary evaluation of the regional geochemical data from the Lower Tauern Mountain range focussed on two objectives: the detection of geochemical anomalies for deposit exploration and the sectoral state of pollution. This programme covered also the analysis of the fine-grain moiety of creek bed sediments (c. 30,000 samples) for 36 chemical elements. The monovariant and multivariant methods employed in primary evaluation allowed to identify three indication types for exploration: in-situ mineralization; slightly covered deposit; deep-lying covered mineralization. The results obtained for these three types in the Lower Tauern Mountain Range region are summarized in a commentary and the geochemical anomalies mentioned are indications of non-ferrous metal mineralizations if not stated otherwise. Maps of geochemical areas define element values to be expected regionally and - since this concerns a region which is relatively sparsely populated - they state the mean geochemical values for the corresponding rock types. Based on this regional distribution pattern of elements which needed to be documented only once, follow-up examinations will allow to easily detect any changes occurring subsequently and to assign these to their respective polluter(s).

35908 **Mass extinctions caused by large bolide impacts.** Alvarez, L.W. (Lawrence Berkeley Laboratory). *Physics Today;* **40**: No. 7, 24-35(Jul 1987).

Evidence indicates that the collision of Earth and a large piece of Solar System derbris such as a meteoroid, asteroid or comet caused the great extinctions of 65 million years ago, leading to the transition from the age of the dinosaurs to the age of the mammals.

35909 **Data compilation and consensus value determination of NBS, USGS, and CCRMP reference materials.** Gladney, E.S. (Los Alamos National Lab., NM). pp vp of 193rd American Chemical Society national meeting. Washington, DC; American Chemical Society (1987). (CONF-870410—).

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

Since the introduction of G-1 and W-1 by the US Geological Survey (USGS) as reference rock samples in 1951, the use of reference materials in analytical chemistry has become widespread. The US National Bureau of Standards (NBS), the USGS, and the Canadian Certified Reference Materials Project (CCRMP) have all developed similar, careful reference material selection and preparation processes. However, they use widely divergent processes for materials characterization. NBS primarily uses in-house capabilities to certify the composition of their reference materials, while the USGS and CCRMP use a mixture of the internal measurement and external round-robin approach. The USGS compiles the data and derives recommended values, while the CCRMP establishes certified concentrations for one or more constituents in each reference material. Many investigators outside the agencies producing reference materials make their own determinations of elemental composition of these reference materials. These data are often sent to one of the well-known compilers of reference material data, or published in the open literature. There are as many different approaches to the assignment of concentration values derived from the compiled data as there are compilers. The author will contrast and compare a number of these methods, and attempt to assess the results of the varying methodologies. They currently have over 80,000 individual data points from over 4000 different references available for NBS, USGS, and CCRMP materials, and their approach to data compilation and the assignment of consensus values will be presented in detail.

5805 Oceanography

REFER ALSO TO CITATION(S) 34675, 34676, 35953

64 PHYSICS I

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 35401, 35522, 35954, 35967, 36030, 36064

35910 **(AD-A—177920/6/XAB) Visible helium spectrum of a white-light flare.** Lites, B.W.; Neidig, D.F.; Trujillo Bueno, J. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Feb 1986. 18p. (AFGL-TR—87-0075). NTIS, PC A02/MF A01.

Pub. in The Lower Atmosphere of Solar Flares, 101-116(Feb 1986).

Emission lines of neutral and ionized helium at visible wavelengths are measured in the white-light flare of 24 April 1981. These intensities, along with accompanying profiles, are presented for the purpose of providing an observational basis for future radiative-transfer models of white-light flares. Absolute intensities, both peak and integrated, are given for 14 lines of Helium I, and for the He II line at 4686. Intensities are compared of these lines in the white-light emitting region to intensities measured in a flare kernel that does not show significant continuum emission. From this, we infer that the white-light emission arises from material at chromospheric temperatures, and not from temperatures greater than about 20,000 K. A search for Stark-enhanced forbidden neighbors to the allowed He I lines in this disk flare was unsuccessful. From measurements of the He I 4026 line profile in the non-white-light emitting kernel of this flare, we set an extreme upper limit on the electric field in the He I emitting region of 1400 V per cm.

35911 **(AD-A—177921/4/XAB) White-light flares and atmospheric modeling.** Machado, M.E.; Avrett, E.H.; Falciani, R.; Fang, C.; Gesztelyi, L. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Feb 1986. 8p. (AFGL-TR—87-0077). NTIS, PC A02/MF A01.

Pub. in The Lower Atmosphere of Solar Flares, 483-488(Feb 1986).

Questions addressed were: (1) What is the range of observed parameters in terms of spectra, temporal development, and spatial development. (2) Which is (are) the emission mechanism(s) favored by observations. (3) Can a working model (semi-empirical type) be established to try and see the possibilities to produce continuum emission by different radiative processes. (4) Which are the causes of white-light flare (WLF) emission. (5) What is needed from the observational and theoretical sides to improve our knowledge on white-light flares.

35912 **(AD-A—177922/2/XAB) Steady flows in active regions observed with the He I 10830 A line.** Lites, B.W.; Keil, S.L.; Scharmer, G.B.; Wyller, A.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1985. 16p. (AFGL-TR—87-0079). NTIS, PC A02/MF A01.

Pub. in Solar Physics, Vol. 97, 35-49(1985).

The Helium 1 10830 A line gives reliable Doppler shift measurements in the upper chromosphere above active regions. Persistent flow patterns in active regions observed near the solar limb show features previously noted in Dopplergrams using the C IV transition region ultraviolet emission line. Unlike the C IV measurements, however, the Helium 1 absorption shows a strong correlation with the line of sight velocity images in certain regions of some active regions.

35913 **(AD-A—177923/0/XAB) Effects of acoustic-gravity waves on the K I 7699 line.** Severino, G.; Roberti, G.; Marmolino, C.; Gomez, M.T. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 16p. (AFGL-TR—87-0078). NTIS, PC A02/MF A01.

Pub. in Solar Physics, Vol. 104, 259-272(1986).

The effects are examined of acoustic gravity waves with long and short periods on the solar profile of the Potassium 1 7699 line using a dynamic model of line formation. First we studied the kinetic equilibrium of the K 1 atoms in a static atmosphere confirming with up to date atomic data and atmosphere model that a good fit of the resonance line 7699 is possible only when non-LTE effects are accounted for. Then the static non-LTE line source function and lower level population are used as input data for calculating the line formation in the presence of waves. The time behavior of the synthetic profiles corresponding to 300 s and 30 s waves is extensively discussed. The characteristic redshift induced by the 30 s wave is explained within the framework of the S-S line formation model. Long-period waves yield an anticorrelation between the asymmetry at different residual intensities and the line core shift, as observed. The short-period waves with velocity amplitude of about 100 m/s (as the base of the photosphere) produce a mean bisector whose lower part has a slope in agreement with the observed one. The efficiency of waves to produce macro and microturbulence is also discussed.

35914 **(AD-A—178215/0/XAB) IRAS large-beam and ground-based small-beam measurements of the unidentified 11.3- and (Ne ii) 12.8-micron line fluxes in the starburst galaxy M82.** LeVan, P.D.; Price, S.D. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 15 Jan 1987. 5p. (AFGL-TR—87-0087). NTIS, PC A02/MF A01.

Pub. in Astrophysical Jnl., Vol. 312, No. 2, 592-595(15 Jan 1987).

The low-resolution-spectrometer data obtained by IRAS on M82, when compared with smaller ground-based beam 8-14 micrometer spectra, provide interesting beam-dependent ratios of the fluxes for the unidentified 11.3-micrometer emission feature, the (NeII) 12.8-micrometer fine-structure line, and the 10 micrometer continuum. Specifically, the relative strengths of the 11.3-micrometer feature and the 10-micrometer continuum are constant for the small and large beam diameters, concordant with published interpretations of both as being associated with dusty regions of thermal radiation. By contrast, the relative strength of either the 11.3 micrometer feature or 10-micrometer continuum fluxes to the (NeII) 12.8-micrometer line flux increases modestly from the smaller to the larger IRAS beam diameter. This is taken as evidence for significant amounts of warm dust above that associated with the H2 regions in the nucleus of M82.

35915 **(AD-A—178305/9/XAB) MINIMUF-85: an improved hf MUF prediction algorithm. Interim report.** Sailors, D.B.; Sprague, R.A.; Rix, W.H. (Naval Ocean Systems Center, San Diego, CA (USA)). Jul 1986. 111p. (NOSC/TR—1121). NTIS, PC A06/MF A01.

An improved version of MINIMUF-3.5, called MINIMUF-85, was developed to predict accurate maximum usable frequencies (MUFs) under conditions of anomalously high sunspot numbers; also, to predict values of fOF2 suitable for ray-tracing applications, to predict m3000 factor values usable for determining the mirror height of reflection for oblique incidence propagation, and to predict accurate MUFs for paths having a portion of the path in the polar region. This version includes sunspot-number curve, reducing the error in predicted MUF values under very high sunspot-number dependence in both FOF2 and the M-factor calculations and provides a natural saturation in the MUF versus sunspot-number conditions. The polar and nonpolar FOF2 models are welded together by means of a folding function. MINIMUF-85 predicts 0.14 MHz low on average and has an error of 4.08 MHz; whereas; MINIMUF-3.5 had a bias of 0.51 MHz low and an 4.33 rms error when compared on the same 39 paths. The subjects of the choice of solar index for forecasting purposes, of sounder updating, of the effects of the underlying layers on both M-factor estimation and determination of the mirror height of reflection, and of future improvements in MINIMUF are discussed.

35916 **(AD-A—178514/6/XAB) Upper limit on the sizes of shepherding satellites at saturn's ring G. Progress report.** Van Allen, J.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). 1 Feb 1987. 9p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A2, 1153-1159(1 Feb 1987).

An accurate analytical theory of the absorption of energetic magnetospheric particles by an inert satellite is developed for the case in which the radius b of the satellite is much less than the equatorial gyroradius r/sub g/ of the particles and in which r/sub

g/ is in turn much less than the radius r of the satellite's orbit. In previous interpretations of Pioneer 11 observations an estimate of the lifetime against absorption of energetic protons (E > 80 MeV) at Saturn's ring G was made. This lifetime is used in the framework of the absorption theory to establish an upper limit on the sizes of shepherding satellites associated with the ring. The resulting upper limit, ignoring the absorption of the optically observed particulate matter, is sum from i=1 to N of (b sub I) = 6 sq km (uncertain by a factor of 2) for an assemblage of N satellites of various radii sub i. It is noted that ring G lies outside the Roche limit. No shepherding satellites at ring G were detected optically by Voyagers 1 and 2, though the lower limit of sensitivity of this technique was b about 10 km for an albedo exceeding 0.1 and the searches were not comprehensive in lognitudinal coverage.

35917 **(AD-A—179036/9/XAB) Semi-automated detection of interplanetary objects.** Taff, L.G.; Yakutis, A.J.; Haase, R.L.; Jonuskis, D.M. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 7 Feb 1988. 8p. (MS—7031). NTIS, PC A02/MF A01.

Pub. in SPIE, Vol. 627, 155-161(1986).

The search for, detection of, and discrimination among moving objects has been a labor-intensive, time-consuming task. Earth-approaching asteroids, tenth planets, comets, meteoroids, and so on fill part of the solar system in an unpredictable way. A state-of-the-art, low-light-level, beam-scanned, electron-bombarded-silicon television camera on a telescope equipped with a microprocessor/minicomputer control system, has been used to search for Earth approaching minor planets for several years. Two generations of ever-increasingly sophisticated analog and digital video data handling and image processing have now been upgraded with the addition of a VICOM Systems Inc. model 1800 digital image processor. The VICOM, with its own microprocessor, real-time digital video-disc storage, and other peripherals allows for the real time implementation of video-processing algorithms that discriminate moving objects from the stellar background. It is hoped that this process will be fully automated with the replacement of the current cameras by state-of-the-art, very-low-noise, very-high-transfer efficiency, and high-quantum-efficiency charge-coupled-device cameras. The capabilities of this system would be such that searches for variable intensity (but fixed in position) sources are feasible too. Whether supernovae, novae, flare stars, or other types of variability are sought, this would be the next step for the observatory. However, the detector/data-handling/control/image-processing problems associated with this task are much more difficult to solve.

35918 **(FNAL/C—87/86-A) Inflation in the universe.** Turner, M.S. (Fermi National Accelerator Lab., Batavia, IL (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.). May 1987. Contract AC02-76CH03000. 28p. (CONF-8703143—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010909.

From Workshop on superstrings, composite structures, and cosmology; College Park, MD, USA (11 Mar 1987).

The hot big bang cosmology, or the standard cosmology as it is appropriately known, is a highly successful model, providing a reliable and tested accounting of the Universe from 0.01 sec after the bang until today, some 15 Gyr later. However, very special initial data seem to be required in order to account for the observed smoothness and flatness of our Hubble volume and for the existence of the small primeval density inhomogeneities required for the formation of structure in the Universe. Inflation offers a means of accounting for these special initial data, which is based upon physics at sub-planck energy scales (<< m/sub pl/ $\simeq 10^{19}$ GeV) and is motivated by contemporary ideas in particle theory. Here I review the status of the 'Inflationary Paradigm'. At present essentially all inflationary models involve a very weakly-coupled (quantified by the presence of a dimensionless parameter of order 10^{-12} or so) scalar field which is displaced from the minimum of its potential. Regions of the Universe where the scalar field is initially displaced from its minimum undergo inflation as the scalar field relaxes, resulting in a Universe today which resembles ours in regions much larger than our present Hubble volume ($\simeq 10^{28}$ cm), but which on very large scales (>> 10^{28} cm) may be highly irregular. The most conspicuous blemish on the paradigm is the lack of a compelling particle physics model to implement it. I also review some other unresolved issues, and discuss in detail the all important confrontation between inflation and observational data. Finally, I discuss the possibility that inflation leads to large-scale, primeval magnetic fields of sufficient strength to be of astrophysical interest. 123 refs., 4 figs.

35919 **(FNAL/Pub—87/92-A) Variational study of ordinary and superconducting cosmic strings.** Hill, C.T.; Hodges, H.M.; Turner, M.S. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jun 1987. Contract AC02-76CH03000. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010940.

A variational approach is used to study Abelian vortices, both the ordinary and bosonic superconducting variety. Accurate results are presented for the energy per length. For superconducting strings the parameter space of solutions is mapped out, the critical current is quantified, the quench transition is studied, and the possibility of static solutions is investigated where electromagnetic stresses balance the string tension. 13 refs., 2 figs.

35920 **(ITA—63) Frequency distribution of sunspot types according to the Waldmeier classification.** Ringnes, T.S. (Oslo Univ. (Norway). Inst. for Teoretisk Astrofysikk). 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752184.

The distribution of sunspot groups of different types according to the Waldmeier classification scheme, varies with time. Changes occur with phase in the eleven year sunspot cycle, but secular variations which seem to indicate the presence of the 80-year period, are also present. Not only does the distribution of types determined from the daily observations change, but also the type groups of sunspots reach when they are at their maximum phase of evolution. In the paper results from calculations of N/sup K//sub Y/ from 1938 to 1979 are reported, using Zuerich data. The variation from year to year and the behaviour of the three year sliding mean have both been studied. 16 refs.

35921 **(PB—87-170668/XAB) New spectral-line identifications in high-temperature flares.** Fawcett, B.C.; Jordan, C.; Lemen, J.R.; Phillips, K.J.H. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 47p. (RAL—86-094). NTIS, PC PC E04/MF E04.

A solar-flare spectrum in the wavelength region between 7.8 and 10.0 A, recorded by the Flat Crystal Spectrometer on Solar Maximum Mission during a flare on 1985 July 2, is presented. It includes several spectral-emission lines not hitherto reported. Most are identified through comparison with wavelengths either measured in laser-produced spectra or calculated at initio. It is found that they are mainly due to n = 2 - 4, 5 transitions in Fe XIX to Fe XXIII. In a few cases, previous identifications are corrected. The more-intense lines appear in second order in another channel of the spectrometer. The potential of line-intensity ratios for temperature and density diagnostics is discussed.

35922 **Nuclide production by primary cosmic-ray protons.** Reedy, R.C. (Los Alamos National Laboratory, New Mexico). *Journal of Geophysical Research;* **92**: No. B4, 697-702(30 Mar 1987).

The production rates of cosmogenic nuclides in the solar system and in interstellar space were calculated for the primary protons in the galactic and solar cosmic rays. Only thin-target production rates, which are directly applicable to small objects in space, were calculated; however, these results also are used to examine the relative variations in production rates that are possible for large objects. In small objects at 1 AU from the sun, the long-term averge fluxes of solar protons usually produce many more atoms of a cosmogenic nuclide than do the primary protons in the galactic cosmic rays (GCR): the exceptions being nuclides made only by high-energy reactions (such as ^{10}Be). Because the particle fluxes inside meteorites and other large objects in space include many secondary neutrons, the production rates are much higher, and ratios inside large objects are often very different from those produced by just the primary GCR protons in small objects. The production rates of cosmogenic nuclides are calculated to vary by factors of about 2.5 between the extremes for a typical 11-year solar

cycle; this variation is in agreement with measurements of short lived radio nuclides in recently fallen meteorites. The production of cosmogenic nuclides by GCR particles outside the heliosphere is higher by factors of —4 than that by the modulated GCR primaries normally in the solar system. However, there is considerable uncertainty about the fluxes of interstellar protons and, therefore, in the production rates of cosmogenic nuclides in interstellar space. Production rates and ratios for cosmogenic nuclides could be used to identify particles that were from small bodies in space or that were exposed to an unmodulated spectrum of GCR particles. Copyright American Geophysica Union 1987.

35923 **Invisible axions.** Sikivie, P. (Physics Dept., Univ. of Florida, Gainesville, FL 32611). pp 214-227 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—).

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

This paper discusses the strong CP problem and the axion; domain walls; evading the domain wall problems; the axion "energy crisis"; and axions and galaxy formation.

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 35507, 35915

35924 **(AD-A—178207/7/XAB) Model for the low-latitude ionosphere with coefficients for different seasonal and solar cycle conditions. Final report, 1 October 1981-30 June 1986.** Mendillo, M.; Herniter, B. (Boston Univ., MA (USA). Dept. of Astronomy). 1 Nov 1986. 46p. NTIS, PC A03/MF A01.

A new ionospheric model for the low-latitude ionosphere was constructed to provide easy access to electron density profiles (Ne(h)), total electron content (TEC) and 6300A airglow under a variety of conditions. Results from the rigorous theoretical calculations for ionospheric structure at a given time and a site were parameterized to a set of six coefficients that reproduce the individual Ne(h) profiles using a simple algebraic formula. This report summarizes the rationale for such a model, describes the input parameters and methods used to generate the coefficients, and provides a comprehensive set of coefficients. The model covers the low-latitude ionosphere (24 N to 24 S every 4 deg of dip latitude), over the altitude range 180 to 1000km, for every hour of local time. The tabulated coefficients, TEC and 6300 airglow are presented for three seasons (Equinox, June solstice, and December solstice) and two solar cycles (solar maximum and solar minimum).

35925 **(AD-A—178383/6/XAB) Modeling the F region of the high-latitude ionosphere. Final report, 31 December 1985-16 May 1986.** Raitt, W.J. (Utah State Univ., Logan (USA). Center for Atmospheric and Space Sciences). 7 Nov 1986. 57p. NTIS, PC A04/MF A01.

The report summarizes work performed in modeling the characteristics of the high/mid latitude ionosphere in two areas; light-ion distribution in the plasmasphere under diffusive equilibrium conditions and plasma distribution in the F region and topside ionosphere in the Southern Hemisphere as a result of the magnetospheric-induced convection. In addition, there was an attempted experiment on high-latitude ionospheric modification. The light-ion study showed larger solar cycle and diurnal variations in the plasmaspheric light ion content than observed by whistler measurements. The plasma convection studied predicted more-dramatic effects in the gross features of the Southern hemisphere polar region compared to the Northern Hemisphere; this is attributed to the greater offset between the geographic and geomagnetic poles in the Southern Hemisphere. One of the major hemispheric differences observed was the appearance of a dayside trough at certain local lines in the Southern Hemisphere winter. The detection of this feature by ionospheric measurements of 800 km by the DMSP-F4 satellite confirmed the model prediction.

35926 **(AD-A—178386/9/XAB) Daytime F layer trough observed on a macroscopic scale.** Whalen, J.A. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1 Mar 1987. 8p. (AFGL-TR—87-0096). NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vo. 92, 2571-2576(1 Mar 1987).

This paper reports a new technique of observing the high-latitude ionospheric trough which defines its continuity in space and time on a macroscopic scale not previously possible. Vertical ionospheric soundings provide the observations in the midday-to-evening sector where to signature of the trough is found to be a bite out of a factor of 3 10 in the diurnal distribution of the solar-produced electron density at the F-layer maximum. The data base employed is that produced by the extensive array of ionospheric sounders operating at high latitudes in the northern hemisphere at solar maximum. The worldwide extent, high density, simultaneity, and continuity of these measurements make possible the description of the trough for the first time as an integral, spatial entity in its entire daytime extent and UT duration. The technique is demonstrated in studies of 4 days that span the range of activity for the month. On the most disturbed day, the daytime trough is continuous in magnetic latitude remains nearly stationary in this frame of reference for a duration of 14.5 hours UT. A snapshot constructed from multiple simultaneous observations on this day shows the trough to have a continous length of 6000 km and an areas of >4 million sq km. The trough is found to rotate clockwise to earlier magnetic local time by 5.5 hours and to expand equatorward in magnetic latitude by 20° as activity increases from quiet to disturbed. Activity dependence and morphology are consistent with other observations that the trough locates rapid westward convection within the dusk convection cell.

35927 **(AD-A—178407/3/XAB) Current-voltage relationship in auroral current sheets.** Weimer, D.R.; Gurnett, D.A.; Goertz, C.K.; Menietti, J.D.; Burch, J.L. (Regis Coll., Weston, MA (USA). Research Center). 1 Jan 1987. 10p. (SCIENTIFIC—1). NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A1, 187-194(1 Jan 1987).

The current-voltage relation within narrow auroral current sheets is examined through the use of high-resolution data from the high-altitude Dynamics Explorer 1 satellite. The north-south perpendicular electric field and the east-west magnetic field are shown for three cases in which are large amplitude, oppositely directed electric fields which are confined to a region less than 20 km wide. The magnetic-field variations are found to be proportional to the second integral of the high-altitude perpendicular electric field. It is shown that at the small-scale limit, this relationship between Delta B and E is consistent with a linear Ohm's law relationship between the current density and the parallel potential drop along the magnetic field line. This linear relationship had previously been verified for large-scale auroral formations greater than 20 km wide at the ionosphere. The evidence shown here extends our knowledge down to the scale size of discrete auroral arcs.

35928 **(AD-A—178484/2/XAB) Thinning of the plasma sheet during substorms. Technical report.** Hones, E.W.; Bame, S.J.; Fennell, J.F.; Croley, D.R. (Aerospace Corp., El Segundo, CA (USA). Space Sciences Lab.). 17 Mar 1987. 75p. (TR—0086(6940-05)-17). NTIS, PC A04/MF A01.

Concurrent measurements of plasma by the SCATHA satellite in near-synchronous orbit and by ISEE 2 in the near magnetotail are used to examine the phenomenon of plasma-sheet thinning associated with substorms. Results show that thinning occurs in two stages, thought to be attributable to two different processes. For 30-60 minutes before expansive phase offset, gradual thinning occurred over the region from geosynchronous orbit out to 20 RE in the tail. This was attributable to the tail-like configuration thought to lead to neutral line formation and the beginning of magnetic reconnection within the plasma sheet. At expansive phase onset, extreme thinning was seen and is thought to occur as a portion of the plasma sheet (a plasmoid), severed by magnetic connection at a near-earth neutral line, quickly departs tailward. Earthward of the neutral line, the plasma sheet expanded. Results generally support the neutral-line model of substorms.

35929 (AD-A—178534/4/XAB) Comparison of magnetic signatures and DMSP (Defense Meteorological Satellite Program) auroral images at substorm onset. Three case studies. Gelpi, C.; Singer, H.J.; Hughes, W.J. (Boston Univ., MA (USA). Dept. of Astronomy). 1 Mar 1987. 15p. NTIS, PC A02/MF A01.

Pub. in Jnl. of Geophysical Research, Vol. 92, No. A3, 2447-2460(1 Mar 1987).

The relationship is explored between mid-latitude and synchronous-orbit magnetic signatures and the location of the auroral surge at the onset of three isolated magnetospheric substorms. Mid-latitude data come from the Magnetometer Network, synchronous orbit data from the satellites GOES 2 and 3, and auroral data from Defense Meteorological Satellite Program auroral images and auroral magnetograms. It was found that the surge forms with its western edge about 1 hour west of the longitude where the major axis of the mid-latitude Pi 2 polarization ellipse is along magnetic north and where the D component perturbation of the magnetic bay is near zero. These observations are in qualitative agreement with a current wedge consisting of a localized upward current in the west and a longitudinally distributed current in the east. At synchronous orbit the longitude of the surge head appears to separate a region to the west where the magnetic field becomes more taillike from one to the east where the magnetic field becomes more dipolar.

35930 (AD-A—178621/9/XAB) Minimum bandwidths of auroral kilometric radiation. Progress report. Baumback, M.M.; Calvert, W. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Feb 1987. 5p. NTIS, PC A02/MF A01.

Pub. in Geophysical Research Letters, Vol. 14, No. 2, 119-122(Feb 1987).

The bandwidths of the discrete spectral components of the auroral kilometric radiation can sometimes be as narrow as 5 Hz. Since this would imply an apparent source thickness of substantially less than the wavelength, it is inconsistent with the previous explanation for such discrete components based simply upon vertical localization of a cyclotron source. Instead, such narrow bandwidths can only be explained by radio lasing.

35931 (AD-A—178651/6/XAB) Latitudinal motions of the aurora during substorms. Craven, J.D.; Frank, L.A. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Jan 1986. 37p. (U-OF-IOWA—86-4). NTIS, PC A03/MF A01.

Sequences of auroral images obtained with Dynamics Explorer 1 are used to investigate latitudinal motions of the aurora in substorms. Average speeds of poleward motion are about 230 m/s near local midnight for two isolated, small substorms and about 1000 m/s during an intensification within a previously active auroral oval. The speed of poleward expansion measured at about 6-minute temporal resolution can differ greatly from the average speed due to the episodic development of substorms. This poleward motion may be influenced by the sign of the z component of the interplanetary magnetic field. Recovery of the high latitude boundary of the aurora to presubstorm latitudes is first observed in the post-midnight sector. In the premidnight sector the discrete aurora can become stationary for a period of time or even continue further poleward before a retreat to lower latitudes begins. For these substorms the expansion and recovery phases are not separated by about 5 deg poleward leap of the aurora. During the recovery phase, a prominent decrease in luminosities is first observed at intermediate latitudes within the auroral distribution. Given that magnetic-field lines threading these auroral distributions map to the plasma-sheet boundary layer and to the central plasma sheet, respectively, magnetic-field lines at the intermediate auroral latitudes then map to the plasma sheet at distances somewhat > 22 R/sub E/.

35932 (AD-A—178876/9/XAB) Investigations of the polar rain: polar-cap electron precipitation. Master's thesis. Riehl, K.B. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA). School of Engineering). Dec 1986. 94p. (AFIT/GEP/ENP—86D-8). NTIS, PC A05/MF A01.

A study of the characteristics of the polar rain using data from the SSJ/4 sensor on the Defense Meteorological Satellite Program F6 satellite Dawn/Dusk flux gradients are verified as being controlled by the interplanetary magnetic field Y component at least 84% of the time. The IMP Z copmonent is shown to play a role in generating flux gradients. The polar rain is best characterized by a double maxwellian distribution with typical temperatures of 80-90 eV for the low-energy component and 3.6-4.8 keV for the high energy component. The characteristics of the low-energy compenent of the polar rain strongly match those of the solar-wind strahl component, suggesting the polar rain is of strahl origin. But correlations with IMF sector structure and solar-wind parameters do not show the relationships proposed since the unpreferred cap generally has the same polar-rain characteristics as the preferred cap.

35933 (AD-A—178888/4/XAB) Calculation of ray paths in the ionosphere using an analytic ray-tracing technique. Technical report, February 1985-February 1986. Yukon, S.P. (Air Force Rome Air Development Center, Griffiss AFB, NY (USA)). Jul 1986. 21p. (RADC-TR—86-125). NTIS, PC A02/MF A01.

A method for tracing rays in the ionosphere using analytic solutions to approximate path-varying ionospheric potentials is outlined in this report. Using the ionospheric parameters generated by IONCAP and approximating the E-F2 and ground-E layer potential wells by a scaled Morse potential and a linear potential respectively, known solutions to these potentials are promoted to final ray paths by using methods developed for solving the time-dependent Schroedinger equation. The computer code necessary to fit the potentials, connect the solutions at the E-layer peak, and trace arbitrarily launched rays is described.

35934 (AD-A—178896/7/XAB) Total electron content and l-band amplitude and phase scintillation measurements in the polar-cap ionosphere. Klobuchar, J.A.; Bishop, G.J.; Doherty, P.H. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 30 Mar 1987. 9p. (AFGL-TR—87-0104). NTIS, PC A02/MF A01.

The first measurements of absolute Total Electron Content (TEC) and L-band amplitude and phase scintillation was made from Thule, Greenland, a polar cap station, in early 1984. These measurements were made using signals transmitted from the Global Positioning System (GPS) satellites. The variability of the TEC, especially during the afternoon to pre-midnight hours, is large, with increases in TEC above the background values of greater than 100% not uncommon. During one disturbed time, quasi-periodic TEC enhancements having periods as short as ten minutes and amplitudes equal to the background TEC were observed for over two hours. The TEC during some of the disturbed periods in the dark Thule ionosphere exceeded mid-latitude daytime values. Amplitude scintillations were small, not exceeding 3 dB peak to peak during the entire observing period, but they were associated with the times of TEC enhancements, with some evidence for stronger scintillation occurring during the negative gradients of the TEC enhancements. Phase scintillations were highest during some of the times of enhanced TEC, and depend critically upon the phase detrend internal used.

35935 (PB—87-170676/XAB) UK review of radio science, 1984-1986: ionosphere and magnetosphere. Rishbeth, H.; Jones, D.; Barclay, L.W. (Rutherford Appleton Lab., Chilton (UK)). Dec 1986. 24p. (RAL—86-096). NTIS, PC PC E03/MF E03.

Topics discussed include the following: Incoherent scatter radar (Systems and Techniques); Coherent scatter and other sounding methods; Probing the magnetosphere by EM waves; Data analysis and image processing; Basic wave processes in plasmas; Ionospheric plasma instabilities; Ionospheric modification; Magnetosphere plasma instabilities; Influence of the ionosphere on radio systems; Composition, ionization and chemistry; Ionospheric dynamics; Models of the ionospheric Atmospheric interaction with the atmosphere.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 35319, 35399, 36049, 36093, 36108

35936 **(AD-A—178591/4/XAB) Laboratory studies of atomic-collision processes. Final report, 15 November 1983-31 January 1987.** Johnsen, R.; Biondi, M.A. (Pittsburgh Univ., PA (USA). Dept. of Physics). 26 Feb 1987. 3p. NTIS, PC A02/MF A01.

Accomplishments include: dissociative recombination of $O_4(+)$ ions with electrons as a function of electron temperature, development of computer codes to describe electron-energy gain and loss processes in plasmas heated by microwaves, including effects of inelastic collisions with molecules and spatially non uniform fields, development of the rf-conductivity method to determine electron and ion densities in plasmas at atmospheric neutral densities, development of mass-spectrometric techniques to analyze the ion composition of plasmas at high neutral densities, measurements of electron-ion recombination for several ionic species in atmospheric-density helium plasmas; development of computer codes to describe the decay of photoionized plasmas in a high neutral-density environment; measurements of the pressure dependence of positive ion/negative ion recombination over the range from a few hundred Torr to 2 atmospheres; and measurements of the temperature dependence of the first and second steps in the clustering reactions of H_3 CN(+) ions with HCN.

35937 **(AD-A—178767/0/XAB) Momentum-space approach to the relativistic atomic-structure calculations.** Baretty, R.; Ishikawa, Y. (Puerto Rico Univ., Rio Piedras). 1986. 10p. NTIS, PC A02/MF A01.

Pub. in International Jnl. of Quantum Chemistry, Vol. 20, 109-117(1986).

A simple and straightforward derivation of the relativistic no pair equation in momentum space is given for hydrogenic species. This is achieved by starting with a QED Hamiltonian in momentum representation and making a rigorous into a system that contains a single electron but no positrons. The integral equation was solved for a series of hydrogenic systems using the Kwon Tabakin Lande technique. Numerical results were compared with those recently obtained by Hess, who employed the basis-set expansion technique to solve the no-pair equation in configuration space.

35938 **(CONF-870516—9) Temperature dependent electron transport and rate coefficient studies for e-beam-sustained diffuse gas discharge switching.** Carter, J.G.; Hunter, S.R.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008806.

From 5. international symposium on gaseous dielectrics; Knoxville, TN, USA (3 May 1987).

Measurements of the electron drift velocity, w, attachment coefficient, eta/N/sub a/, and ionization coefficient, α/N, have been made in C_2F_6/Ar and C_2F_6/CH_4 gas mixtures at gas temperatures, T, of 300 and 500°K over the concentration range of 0.1 to 100% of the C_2F_6. These measurements are useful for modeling the expected behavior of repetitively operated electron-beam sustained diffuse gas discharge opening switches where gas temperatures within the switch are anticipated to rise several hundred degrees during switch operation.

35939 **(CONF-8706112—1) The emittance and brightness characteristics of negative ion sources suitable for MeV ion implantation.** Alton, G.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02. File Number DE87010377.

From 11. symposium on ion sources and ion-assisted technology; Tokyo, Japan (1 Jun 1987).

This paper provides the description and beam properties of ion sources suitable for use with ion implantation devices. Particular emphasis is placed on the emittance and brightness properties of state-of-the-art, high intensity, negative ion sources based on the cesium ion sputter principle. (WRF)

35940 **(CONF-8706128—1) Third-harmonic generation in both positively and negatively dispersive Xe.** Blazewicz, P.R.; Miller, J.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010913.

From 8. international conference on laser spectroscopy; Are, Sweden (22 Jun 1987).

In the present work, we have investigated modifications of third-harmonic (TH) generation by a second, strong laser. We report the observation of tunable TH light in the positively dispersive region on the low energy side of the Xe $6s'[1/2]_1^o$ state induced upon introduction of a second, strong laser field. We also report observations of strong, systematic increases and decreases in ionization signals generated to the blue of the 6s′ level. Results are interpreted in terms of phase-matching changes induced by the second laser which affect TH production and subsequent ionization of Xe atoms. In addition, we present theoretical expressions developed by Payne and Garrett for the effect of the second laser field on TH production and MPI (multiphoton ionization) on both the positively and negatively dispersive sides of the three-photon resonances.

35941 **(DOE/ER/13440—1) Hyperspherical coordinate theory of two-electron processes: Technical progress report and future plans.** Macek, J.; Starace, A.F. (Nebraska Univ., Lincoln (USA). Dept. of Physics and Astronomy). 1987. Contract FG02-85ER13440. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010653.

The main focus is the theoretical study of the effect of electron correlations on atomic collision processes. The theoretical approaches taken are primarily those based on the hyperspherical coordinate description of many body systems. A major aim of the project is to lay the ground work for state-of-the-art calculations of collision cross sections using hyperspherical coordinate methods. In addition, applications are made to specific atomic collision processs relevant to energy-related research in those cases where a hyperspherical coordinate point of view can significantly contribute to understanding the underlying physical mechanisms. 28 refs., 1 fig.

35942 **(DOE/ER/13456—7) The production and destruction of metastable negative ions: Progress report, September 1, 1986-August 31, 1987.** Pegg, D.J. (Tennessee Univ., Knoxville (USA). Dept. of Physics). 24 Apr 1987. Contract FG05-85ER13456. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008773.

This report describes the progress made during the present grant period in the investigation of the properties of metastable negative ions using fast-beam autodetachment and photodetachment spectroscopy. The autodetachment measurements involved an unsuccessful search for the metastable Ar^- ion and the determination of the ground state He-He potential curve over a limited range of internuclear distances using autodetachment spectroscopy of He_2^-. Preparations were made for photodetachment measurements on He^- and Ca^-. An apparatus designed for photoelectron spectroscopy and cross section measurements was fabricated. A pulsed dye laser and optics for beam steering and polarization measurements were purchased.

35943 **(DOE/ER/53205—T2) [Atomic processes in high temperature plasmas]: Progress report for the two-year period, July 16, 1985-July 31, 1987.** Hahn, Y. (Connecticut Univ., Storrs (USA). Dept. of Physics). 13 Mar 1987. Contract FG02-85ER53205. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010862.

Dielectronic recombination (DR) rates were calculated for the Mg isoelectronic sequence ions, Fe(8+) of the Ar sequence, and the Be sequence. The work on B sequence, Fe(21+), has been initiated. Thus far, we have treated the following isoelectronic sequences; N = 1,2,3,4,10,11,12, and some at N = 18,19, where N is the number of electrons in the ion before capture. External field effect on DR was examined in detail, and the theory is in substantial agreement with experiment in Mg II. The DR-related electron-ion and ion-atom collisions were analyzed, including excitation-autoionization, REDA, and resonant-transfer-excitation.

35944 (DOE/ET/51013—213) The Constance B mirror as a source of highly stripped ions. Smatlak, D.L. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Apr 1987. Contract AC02-78ET51013. 23p. (PFC/RR—87-6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010006.

The potential of the Constance B mirror as a source of highly stripped ions for fundamental atomic physics research is described. The hot electron, cold ion plasma (ntau $>$ 2 x 10^{11} cm^{-3}-s, T/sub eh/=400 keV, T/sub i/ $<$ 20 eV) created by electron cyclotron resonance heating (ECRH) is characterized by a confinement time which is long compared to the ionization for many high Z ions. Calculations indicate that helium-like argon will be formed in Constance when the pressure is reduced to 10^{-8} torr during the decay of the hot electrons. A 28 GHz upgrade machine in which Xe^{+50} could be produced, is also described.

35945 (LBL—22299) Neutralizer options for high energy H^- beams. Fink, J.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 15p. (CONF-8610115—26). NTIS, PC A02. File Number DE87010286.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

A neutralizer converts a negative ion beam into a neutral beam, but it also increases the beamline cost, weight and size while reducing its output power, efficiency and possibly the reliability of the entire system. In addition it scatters the newly formed neutrals, altering the beam current density distribution, causing the beam divergence to get larger and the brightness to go down. In the following, the role of neutralizers for hydrogen ion beams is reviewed, and the problems encountered over a range of beam energies are discussed. Consideration is given to enhancing the goals of the neutral beam application, be they the highest neutral fraction, optimum overall efficiency or maximum beam brightness, etc.

35946 (ORNL/TM—10409) Installation and operation of the ion optical program SIMION. Todd, P.J.; McKown, H.S.; Smith, D.H. (Oak Ridge National Lab., TN (USA)). May 1987. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87011947.

SIMION is a Fortran program that helps design electrostatic lenses. Both equipotential and ion path plots can be obtained. The program has proven extremely useful in numerous applications, ranging from mass spectrometer ion sources to setting up primary beam optics for organic SIMS. This report is a tutorial on its use, leading the user step-by-step through the various options. Examples are given, and a sample lens is analyzed and refined. Anyone with an interest in design of ion optics will benefit from acquiring and applying SIMION, either in its Fortran or its IBM-PC form. It is the former that is described here.

35947 Fine structure in the $[(^2H_3+\nu_3)\leftarrow{}^1\Gamma_1]$ vibronic band in PuF_6. Kim, K.C.; Krohn, B.J.; Briesmeister, R.; Rabideau, S. (University of California, Los Alamos National Laboratory, P. O. Box 1663, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 3, 1538-1539(1 Aug 1987). Contract W-7405-ENG-36.

High resolution spectra of the $[(^2\Gamma_3+\nu_3)\leftarrow{}^1\Gamma_1]$ transition from the absorption band systems near 800 nm in PuF_6 have been recorded. Rotational lines and some fine structures have been resolved. The results support a spherical-top configuration despite the possibility of Jahn—Teller distortion.

35948 Observation of Rydberg transitions from the inner valence shell of ethane. Dillon, M.A.; Tanaka, H.; Spence, D. (Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **87**: No. 3, 1499-1501(1 Aug 1987). Contract W-31-109-ENG-38.

The electron impact spectrum of ethane has been examined in a region that includes ionization out of the inner valence shell. One diffuse structure and a progression of ten vibrational bands have been found in a 4 eV range below and to some degree overlapping the $^2A_2$/sub u/ ion threshold. Evidence indicates that the observed transitions belong to the symmetry forbidden Rydberg series $(2a_2$/sub u/$)^2\rightarrow(2a_2$/sub u/, npσ or npπ).

35949 Rotationally resolved isotope effect in the hot atom collisional excitation of CO_2 (00°1) by time-dependent diode laser spectroscopy. Hewitt, S.A.; Hershberger, J.F.; Flynn, G.W.; Weston R.E. Jr. (Department of Chemistry and Columbia Radiation Laboratory, Columbia University, New York, New York 10027). *Journal of Chemical Physics;* **87**: No. 3, 1894-1895(1 Aug 1987).

High resolution diode laser spectoscopy is used to probe the rotational structure of the CO_2(00°1) state, produced in the inelastic scattering of hot deuterium atoms and CO_2(00°0). A preference for excitation of high J levels relative to low J levels of CO_2(00°1) by hot deuterium atoms compared to hot hydrogen atoms was observed. (AIP)

35950 Three-state model driven by two laser beams. Carroll, C.E.; Hioe, F.T. (Department of Physics, St. John Fisher College, Rochester, New York 14618). *Physical Review [Section] A: General Physics;* **36**: No. 2, 724-729(15 Jul 1987).

We use a three-state model for an atom or molecule in which two transitions are simultaneously driven by the oscillating electric fields of two laser beams. The amplitudes and detunings of the applied oscillating fields vary during the optical pulse, which can cause transitions from one state to another. For some special cases not previously known, the transition probabilities and probabilities of no transition are obtained analytically. We give conditions for complete transfer of the atomic population from one state to another, and for complete return to the initial state.

35951 Collision strengths and oscillator strengths for excitation to the n = 3 and 4 levels of neon-like ions. Zhang, H.; Sampson, D.H.; Clark, R.E.H.; Mann, J.B. (Department of Astronomy, The Pennsylvania State University, University Park, Pennsylvania). *Atomic Data and Nuclear Data Tables;* **37**: No. 1, 17-52(Jul 1987).

Collision strengths are given for the 88 possible fine-structure transitions between the ground level and the n = 3 and 4 levels in 20 neon-like ions with nuclear charge number Z in the range 18 $\leqq$Z$\leqq$74. The results are given for the nine impact-electron energies in threshold units X = 1.0, 1.2, 1.5, 1.9, 2.5, 4.0, 6.0, 10.0, and 15.0. In addition, electric dipole oscillator strengths obtained by various methods are given. copyright 1987 Academic Press, Inc.

35952 Relativistic distorted-wave calculations of electron collision cross sections and rate coefficients for Ne-like ions. Hagelstein, P.L.; Jung, R.K. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Atomic Data and Nuclear Data Tables;* **37**: No. 1, 121-188(Jul 1987). Contract W-7405-ENG-48.

Electron collision data are required for population kinetics modeling and spectral predictions of highly ionized ions in high-temperature plasmas. For highly stripped ions of moderate to high Z, relativistic effects begin to play a role in the atomic physics calculations. We describe numerical techniques which we have employed to compute relativistic distorted-wave inelastic electron collision cross sections from relativistic multiconfiguration bound states. As an application of these techniques, we have calculated full sets of cross sections and rate coefficients between all L-shell and M-shell states of the Ne-like ions Fe, Se, Y, Mo, and Ag. copyright 1987 Academic Press, Inc.

35953 Resonance ionization spectroscopy 1986: Proceedings. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1987). 366p. (DOE/ER/60411—1; CONF-8609132—). IOP Publishing Ltd., Redcliffe Way, Bristol Way, Bristol BS1 6NX, England. File Number TI87010199. Contract FG05-86ER60411.

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

The main sessions were devoted to the following: (1) Photophysics and Spectroscopy, dealing primarily with the basic physics of multiphoton and multiple photon ionization, with special emphasis on the role and application of Rydberg states; (2) to Noble Gas Atom Counting - reporting significant advances in techniques and

results relevant to oceanographic, geological and astrophysical studies; (3) to Mass Spectrometry coupled to Resonance Ionization, RIMS, embracing wide ranging studies of physical and chemical phenomena involving the need for elemental, isobaric and isotopic selectivity and separation at the ultra trace level; (4) Materials and Surface Analyses dealing with sustained advances in the application of RIS and associated sample preparation techniques for the quantitative analysis of a variety of substances and substrates at the parts per billion level; (6) Small molecules - the extension of resonance ionization techniques, hitherto confined to atomic systems, to investigate the properties of molecules such as hydrogen isotopes, the important topic of cluster formation which effectively bridges the gap between the gaseous and condensed matter phases; and finally (7) to Medical and Environmental Applications. Individual papers have been cataloged separately.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 36166, 36197

35954 **(AD-A—178998/1/XAB) Nonlinear aspects of planar condensational instability. Memorandum report.** Dahlburg, R.B.; DeVore, C.R.; Picone, J.M.; Mariska, J.T.; Karpen, J.T. (Naval Research Lab., Washington, DC (USA)). 27 Feb 1987. 62p. (NRL-MR—5922). NTIS, PC A04/MF A01.

The nonlinear evolution of a radiation-driven thermally unstable planar fluid, using a semi-implicit finite-difference algorithm was simulated numerically. When the equilibrium state of the fluid is perturbed by random initial excitation of the velocity field, dense, cool, two dimensional structures are observed forming in a rarer, warmer, surrounding medium. The nonlinear phase of evolution is characterized by the turbulent contraction of the condensed region, accompanied by a significant increase in the amount of energy radiated. If the random velocity perturbation has a sufficiently large amplitude, the fluid will not form condensed structures. Finally, the relationship of these results to observations of the solar chromosphere, transition region, and corona is discussed.

35955 **(LA—11000-MS) Local thermodynamic equilibrium study of H^- abundance in negative-ion source discharges.** Mondt, J.P.; Keady, J.; Sharp, C.; Gerwin, R.A. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010837.

A local thermal equilibrium study of a hydrogen gas has been carried out for temperatures and densities relevant to the expected conditions in the Penning SAS source, which is a negative-ion source presently under investigation by AT-2 at Los Alamos National Laboratory. For the pure hydrogen mixture, it was found that the relative abundance of H^- ions peaks at about 10,000 K but is extremely low. The inclusion of cesium does improve the H^- abundance significantly only at low temperatures ($\leq$5000 K), raising it to about several parts per million, which should be considered low in view of estimates from the sheath physics which is not based on the local thermodynamic equilibrium assumption. Incorporation of the enhancement of dissociative attachment from contributions by higher rotational-vibrational states associated with a nonthermal hot electron component has not been attempted, being an intrinsically nonthermal effect. The higher rotational-vibrational states themselves are, however, fully included.

35956 **(LA—11001-MS) CAVEAT calculations of shock interactions.** Sandoval, D.L. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010838.

CAVEAT is a computer code for calculating the time-varying fluid dynamics of several adjacent materials in two or three space dimensions. Using an extended Godunov technique and adaptive meshing, the code allows for large slippage at material interfaces. To exhibit the capability for calculating strong distortions we have performed a variety of calculations describing the interaction of shocks with rigid wedges, cylinders, and spheres and deformable cylindrical, spherical, and conical shells in two space dimensions. Comparison of the results with experimental data and analytical solutions demonstrates the considerable accuracy that can be expected from calculations with this code.

35957 **Universality of the cluster integrals of repulsive systems.** Baram, A.; Luban, M. (Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Physical Review [Section] A: General Physics;* **36**: No. 2, 760-765(15 Jul 1987). Contract W-7405-ENG-82.

We provide evidence for the universal behavior of the exponent characterizing the singularity of the Mayer fugacity series for the pressure of a fluid. As long as the two-body potential is positive but otherwise unrestricted, this exponent appears to be independent of the form of the potential and it is a monotonic, slowly increasing function, phi(D), of the dimensionality D of the system. A limited version of universality has previously been proposed by Poland [J. Stat. Phys. 35, 341 (1984)], restricted to hard, approximately spherical particles. Our results for phi(D) differ somewhat from those of Poland.

35958 **Supersonic inviscid flow: A three-dimensional characteristics approach.** Fong, J.; Sirovich, L. (Supercomputer Computations Research Institute, Florida State University, Tallahassee, Florida 32304-4052). *Journal of Computational Physics;* **68**: No. 2, 378-392(Feb 1987).

Supersonic inviscid flow over nonaxisymmetric bodies is considered. A new version of the method of reference planes is used. In this version, a near characteristics—streamlines coordinate system and a highly efficient numerical integration scheme is developed. The CFL condition is rigorously satisfied on the flow. Several sample calculations are presented. copyright 1987 Academic Press, Inc.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 35953, 35991, 36001, 36014

35959 **(BNL—39471) Exclusive reactions and dimensional scaling: New measurements and new understanding.** Carroll, A.S.; Barton, D.S.; Bunce, G.; Gushue, S.; Makdisi, Y.I.; Baller, B.; Blazey, G.C.; Courant, H.; Emond, M.; Russell, J.J. (Brookhaven National Lab., Upton, NY (USA); Minnesota Univ., Minneapolis (USA); Southeastern Massachusetts Univ., North Dartmouth (USA)). Jan 1987. Contract AC02-76CH00016. 9p. (CONF-870121—6R). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008708.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

This experiment has measured 11 meson-baryon and 2 baryon-baryon cross sections at 90°. When interpreted in terms of underlying hard quark-quark scattering diagrams, the process of quark interchange between the incident hadrons clearly dominates over other graphs such as pure gluon exchange amd quark annihilation/creation. While there is no theoretical prediction for this dominance yet, there is an indication of underlying simplicity. In a continuing program at the Brookhaven AGS we have initial indication of a strikingly large cross section for proton-proton elastic scattering inside nuclei at 90° and incident momentum of 10 GeV/c ($-t = (9\ \mathrm{GeV/c})^2$). This result suggests that those protons which scatter elastically to large angles have a smaller cross section for additional interactions (less shadowing) while traversing a nucleus than those undergoing normal small momentum transfer collisions, an effect predicted by the above interpretation. 11 refs., 8 figs.

35960 **(BNL—39629) Matter oscillations: Neutrino transformation and regeneration in the earth.** Baltz, A.J.; Weneser, J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 16p. (CONF-870283—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010051.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Transformation and regeneration phenomena are calculated to result from transmission through the Earth of neutrinos with $E(MeV)/\Delta m^2(eV)^2$ in the vicinity of 10^6 to 10^7. As a result, large time-of-night and seasonal variations are predicted for various solar neutrino experiments in this parameter range. Analagous effects are predicted for terrestrial cosmic ray and accelerator experiments.

35961 **(BNL—39667) A search for nu/sub μ/ → nu/sub e/ oscillations using the E734 detector.** Murtagh, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 9p. (CONF-870283—8). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010058.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

No evidence for nu/sub μ/ → nu/sub e/ oscillations is observed in an experiment in the wide band beam at Brookhaven National Laboratory using the E734 neutrino detector. The 90% confidence level limits obtained are $\sin^2 2\alpha \leqq 3.4 \times 10^{-3}$ in the large mass difference limit and $\Delta m^2 \sin 2\alpha < 0.43 eV^2$ in the small mass difference limit.

35962 **(BNL—39668) Future long baseline ν/sub μ/ → ν/sub e/ oscillation searches at accelerators.** Murtagh, M.J. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-870283—9). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010068.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The additional neutrino flux available when the Booster at the AGS become operational will make possible ν/sub μ/ → ν/sub e/ oscillation searches at Brookhaven which significantly extend beyond the present limits.

35963 **(BNL—39737) A search for heavy neutrino decays in a neutrino beam.** Ahrens, L.A.; Aronson, S.H.; Gibbard, B.G.; Murtagh, M.J.; White, D.H.; Callas, J.L.; Cutts, D.; Diwan, M.; Hoftun, J.S.; Lanau, R.E. (Brookhaven National Lab., Upton, NY (USA); Brown Univ., Providence, RI (USA). Dept. of Physics; Hiroshima Univ. (Japan). Dept. of Physics; National Lab. for High Energy Physics, Oho, Ibaraki (Japan); Osaka Univ., Toyonaka (Japan). Dept. of Physics; Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1987. Contract AC02-76CH00016. 11p. (CONF-8703121—2). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010449.

From Telemark IV - neutrino mass and neutrino astrophysics; Ashland, WI, USA (16 Mar 1987).

Decay of heavy neutrinos ν/sub H/ → $\nu l \mu e (l = e, \mu)$ has been searched for in the Brookhaven Alternting Gradient Synchrotron wide-band neutrino beam. Since no significant excess of such events was found, upper limits on the neutrino mixing matrix elements, absolute value of U/sub $eH/^2$ and absolute value of U/sub $\mu H/^2$ were obtained for the mass range of 180 to 500 MeV.

35964 **(BONN-IR—83-21) Particle production in proton-antiproton reactions at 540 GeV c.m. energy.** Mueller, T. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). Aug 1983. 169p. (In German). NTIS, PC E14; Available from NTIS as TIB/B86-10173.

In this thesis results on the particle production in inelastic proton-antiproton reactions at 540 GeV c.m. energy are shown. The results origin from data of the streamer chamber experiment UA5 from its first measurement period in the autumn 1981 at the CERN collider.

35965 **(DESY—86-027) Measurement of the D/sup 0/ lifetime.** Althoff, M.; Braunschweig, W.; Gerhards, R.; Kirschfink, F.J.; Martyn, H.U.; Rosskamp, P.; Wallraff, W.; Bock, B.; Eisenmann, J.; Fischer, H.M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1986. 19p. NTIS, PC E07; Available from NTIS as TIB/B87-00400.

We have determined the D/sup 0/ lifetime from reconstructed vertices of D/sup 0/ mesons produced in e/sup +/e/sup -/ annihilations at an average center of mass energy of 42.2 GeV. From fifteen events the D/sup 0/ lifetime was determined to be (4.3/sup +2.0//sub -1.4/ +- 0.8) . 10/sup -13/s.

35966 **(DESY—86-028) Measurement of the radiative width of the A/sub 2/(1320) in two-photon interactions.** Althoff, M.; Braunschweig, W.; Gerhards, R.; Kirschfink, F.J.; Martyn, H.U.; Rosskamp, P.; Wallraff, W.; Bock, B.; Eisenmann, J.; Fischer, H.M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Apr 1986. 19p. NTIS, PC E07; Available from NTIS as TIB/B87-00414.

The reaction e/sup +/e/sup -/->e/sup +/e/sup -/A/sub 2/(1320) has been observed by detecting the decay A/sub 2/->π/sup +/π/sup -/π/sup 0/. The two-photon width of the A/sub 2/ has been measured to be $\Gamma(A/sub\ 2/->\gamma\gamma) = (0.90 +- 0.27\ (stat.) +- 0.16\ (syst.))$ keV. The cross section $\sigma(\gamma\gamma->\pi$/sup +/π/sup -/π/sup 0/) has been determined outside the A/sub 2/ resonance region.

35967 **(DOE/ER/03230—T6) Research in elementary particle physics: Technical progress report, June 1, 1986-May 31, 1987.** Kirsch, L.E.; Schnitzer, H.J.; Abbott, L.F.; Bensinger, J.R.; Blocker, C.A. (Brandeis Univ., Waltham, MA (USA). Dept. of Physics). 1987. Contract AC02-76ER03230. 26p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011706.

Work is reported in the areas of: design, construction, and testing of components of the CDF, including shower counters, electronics, and electron identification algorithms; contributions to the design and construction of the Brookhaven MultiParticle Spectrometer; search for charm and K*'s and baryonium; measurement of differential cross section and polarization in the Lambda-anti-Lambda channel; a study of Xi states which measured the Xi asymmetry parameter; and dibaryon searches using the Brookhaven Hypernuclear Spectrometer. Theoretical efforts are reported in the areas of string theory, the Skyrme model applied to elementary particle phenomenology, quantum field theory, cosmology, galaxy formation, supernova 187A, field theory in curved space-times, and spin-glasses. (LEW)

35968 **(DOE/ER/13065—487) Nu production of same-sign dimuons at the Tevatron.** Merritt, F.S.; Oreglia, M.J.; Schellman, H.S.; Schumm, B.A.; Bachmann, K.T.; Bernstein, R.H.; Blair, R.E.; Foudas, C.; Lefmann, W.C.; Leung, W.C. (Chicago Univ., IL (USA); Columbia Univ., New York (USA); Fermi National Accelerator Lab., Batavia, IL (USA); Rochester Univ., NY (USA)). Apr 1987. Contract AC02-76ER13065. 7p. (CONF-870390—4; UR—999). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010233.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

New results on the production of $\mu^-\mu^-$ and $\mu^+\mu^+$ events in neutrino and antineutrino interactions with energies 30 to 600 GeV are presented. The results are based on 850,000 neutrino and antineutrino events in the CCFR detector. We find no convincing evidence for anomalous same-sign dimuon production.

35969 **(DOE/ER/40125—9) Indiana University High Energy Physics Group: Task A: Technical progress report, December 1, 1986 to November 30, 1987.** Alyea, E.D.; Brabson, B.B.; Crittenden, R.R.; Dzierba, A.R.; Martin, H.J.; Ogren, H.O.; Zieminski, A. (Indiana Univ., Bloomington (USA). Dept. of Physics). May 1987. Contract AC02-84ER40125. 90p. NTIS MF A01; 2; GPO Dep. File Number DE87010091.

Data collection on the production of the KKπ state in π^-, K^-, and p-bar induced reactions is reported, with partial wave analysis in progress. Work on the design of a target calorimeter and data taking for a muon scattering experiment at CERN is completed. Analysis of a fixed-target jet experiment is reported. A dimuon detector has been prepared for an experiment at Fermilab to study hadronic processes yielding high mass dimuons and associated particles. Participation in the coordination and writing of software for the DO collider detector at Fermilab is reported. Some results from the High Resolution Spectrometer (HRS) are reported, including direct observation of several decay modes of the charmed mesons,

directly observed meson resonances, baryon resonances, and some discoveries concerning the tau lepton. Activity is reported in the building of hardware for the muon upgrade for the Mark2 detector at the SLC and the building of the beam position monitors for the SLC, and microprocessors for Mark2 data analysis. Involvement in the SLC polarization collaboration is also reported. (LEW)

35970 **(DOE/ER/40150—16) Spin physics at intermediate energies.** Burkert, V. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). 1986. Contract AC05-84ER40150. 14p. (CEBAF-PR—86-012; CONF-8609151—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008670.

From 7. international symposium on high energy spin physics; Protvino, USSR (22 Sep 1986).

In this session a total of 25 contributed papers were presented studying a broad range of spin effects in nucleons and nuclei using electromagnetic (electrons and photons) and hadronic (pions and nucleons) probes. The status of the theory was characterized by its almost total absence. Only one theoretical contribution was presented at this session. Those experiments examining electromagnetic-, electroweak- and weak-strong interactions were emphasized.

35971 **(DOE/ER/40243—4) Medium energy elementary particle physics: Technical progress report, 11/1/86 thru 5/28/87.** (Yale Univ., New Haven, CT (USA). Dept. of Physics). 1987. Contract FG02-86ER40243. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011086.

We have searched for spontaneous conversion of muonium (M identical to μ^+e^-) to antimuonium (anti M identical to μ^-e^+) at LAMPF. When μ^+ of 10 MeV/c pass through an Al foil (0.2 mg/cm^2), M atoms with kinetic energies of 1 to 20 keV are formed by e^--capture. They pass a drift space of 342 cm, of which 206 cm is magnetically shielded to ≦20 mG, and are stopped on a 1 μm thick Bi target, which was evaporated onto a 2 mil mylar backing and coated with 75 A of MgO. The impact of M or anti M atoms on the target liberates about 5 secondary electrons each with kinetic energies of a few eV. These are electrostatically collected and guided onto a microchannel plate detector, using electric fields of about 100 V/cm. We have counted M at 1 to 20 keV with 50% efficiency using this 0.4 m^2 area active target. If an oscillation of M to anti M has occurred, stopping an anti M atom will entail formation of a Biμ^- atom and emission of its characteristic muonic x rays. The crystal box detector then detects the coincident Lα and Kα x rays at 4% efficiency. The anti M event signature was defined as a triple coincidence of a Biμ^- Lα x ray, a Kα x ray, and a count in the M(anti M) secondary emission counter. No statistically significant signal was seen and our preliminary data analysis yields an upper limit of G/sub M anti M/ ≦ 8 G/sub F/ (95% C.L.) on the coupling constant of a four-Fermion contact interaction. The current published limit is G/sub M anti M/ ≦ 20 G/sub F/. A conversion of M to anti M is forbidden in the standard model, since it would violate additive lepton flavor conservation. However, an alternative theory based on a lef-tright symmetric model allows the M → anti M coupling at G/sub M anti M/ - 10 G/sub F/. 8 refs., 4 figs.

35972 **(DOE/ER/40297—T1) High energy particle physics: Contract status report covering period 7/1/86-1/30/87.** Judd, D.J.; Wagoner, D.E. (Florida Agricultural and Mechanical Univ., Tallahassee (USA)). 1987. Contract FG05-86ER40297. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87006336.

The work reported includes the experimental study of charmonium production in hadronic interactions and direct photon production in hadronic interactions. The status of the direct photon experiment is reported with regards to the experimental apparatus, including drift chambers and beam chambers, a high P/sub t/ photon cluster finder and precision ADC system, triggering circuits, data acquisition system. Also discussed are offline reconstruction of events and online software. (LEW)

35973 **(DOE/ER/40304—5) Parity violating weak neutral current effects in elastic e-^{12}C scattering: Progress report, 1 June 1986-22 May 1987.** Lubell, M.S. (City Coll., New York (USA). Dept. of Physics). 26 May 1987. Contract FG02-86ER40304. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010366.

Progress made on the Bates Parity Experiment and on the polarized electron source are described. The first Moller scattering polarization measurements were completed and the first parity studies with the polarized beam were undertaken. Source intensities were increased to values approaching the design specification, and lifetimes were improved dramatically.

35974 **(FNAL/C—87/51) Experimental search for W/Z pairs and Higgs bosons at very high energy hadron-hadron colliders.** Alverson, G.; Bengtsson, H.U.; Hauptman, J.; Hedin, D.; Herrero, M.J.; Wang, E.; Linn, S.; Young, C.; Milliken, B.; Paige, F. (Northeastern Univ., Boston, MA (USA); California Univ., Los Angeles (USA); Ames Lab., IA (USA); State Univ. of New York, Stony Brook (USA); Lawrence Berkeley Lab., CA (USA); Florida State Univ., Tallahassee (USA)). Mar 1987. Contract AC02-76CH03000;AC03-76SF00098;AC02-76CH00016. 51p. (CONF-8606215—42). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87009437.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

We study, from an experimental point of view, the main ways to detect standard high mass Higgs bosons (from 300 GeV up to about 1 TeV) when they decay into W- and Z-pairs at the SSC. We also consider the corresponding W- and Z^0-pair continuum which may itself provide interesting physics, and we pay some attention to the case of an intermediate mass charged Higgs decaying into tauν/sub tau/ (m/sub H+-/ = 300 GeV). We first explain why and how high energy pp colliders may search for Higgs' and we compare their possible performances to those of the e^+e^- and ep colliders at all possible mass scale (from few tens of GeV's up to 1 TeV). We then estimate the rates of the signals and the main backgrounds. We define the main characteristics of these events as reproduced by M.C. generators (especially implemented with these processes) and simulated through an idealized 4π fine-grained calorimeter. A trigger strategy for W- and Z-pairs is derived from this study. 26 refs., 28 figs.

35975 **(FNAL/C—87/54) Detecting W/Z pairs and Higgs at high energy pp colliders: Main experimental issues.** Alverson, G.; Bengtsson, H.U.; Hauptman, J.; Hedin, D.; Herrero, M.J.; Wang, E.; Linn, S.; Young, C.; Milliken, B.; Paige, F.; . (Northeastern Univ., Boston, MA (USA); California Univ., Los Angeles (USA); Ames Lab., IA (USA); State Univ. of New York, Stony Brook (USA); Lawrence Berkeley Lab., CA (USA); Florida State Univ., Tallahassee (USA)). Mar 1987. Contract AC02-76CH03000. 74p. (CONF-8606215—43). NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010081.

From Summer study on the physics of the superconducting super collider; Snowmass, CO, USA (23 Jun 1986).

The main detection issues implied by the search for W and Z^0 pairs and Higgs in a high energy pp collider context are discussed here. It includes: precise electron identification, missing energy measurement, multilepton recognition, sophisticated jet pattern recognition, and pile-up. The study uses, as much as possible, a "realistic simulation of life."

35976 **(MPI-PAE/Exp.El.—161) Search for short-lived axions in radiative upsilon decays.** Mageras, G.; Franzini, P.; Tuts, P.M.; Youssef, S.; Zhao, T.; Lee-Franzini, J.; Schamberger, R.D. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Apr 1986. 14p. NTIS, PC E07; Available from NTIS as TIB/B87-00252.

Within the standard axion model, there exists a range of short axion lifetimes allowed by the theory that has not yet been experimentally excluded. We have tested this possibility by searching for the decay Y(1S)->γ+a, where the axion subsequently

decays into an e/sup +/e/sup -/ pair in the detector. We observe no evidence for this decay, and obtain an upper limit for the branching ratio which is inconsistent with the theoretical prediction. We discuss our results in connection with the possible production of a light, neutral particle in heavy-ion collisions.

35977 (MPI-PAE/Exp.El.—168) Measurement of direct photon production at large transverse momentum in πp, $\pi^+ p$ and pp collisions at 300 GeV/c. De Marzo, C.; De Palma, M.; Favuzzi, C.; Maggi, G.; Nappi, E.; Posa, F.; Ranieri, A.; Selvaggi, G.; Spinelli, P.; Bamberger, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Istituto Nazionale di Fisica Nucleare, Bari (Italy); Freiburg Univ. (Germany, F.R.)). Dec 1986. 29p. NTIS, PC E07; Available from NTIS as TIB/B87-05915.

Cross sections for inclusive direct photon production in $\pi^- p$, $\pi^+ p$ and pp collisions at 300 GeV/c are measured at transverse momenta, p/sub T/, up to 7 GeV/c (x/sub T/ = 0.6). For $\pi^- p \geqq \gamma x$ also the rapidity distribution is presented. The cross section ratio $\sigma(\pi^- p \geqq \gamma x)/\sigma(\pi^+ p \geqq \gamma x)$ is found to be one at p/sub T/ = 4 GeV/c and rises with increasing p/sub T/. This observation signals the occurrence of valence quark antiquark annihilation. The results are in good agreement with QCD predictions.

35978 (MPI-PAE/Exp.El.—169) Measurement of $\pi 0$-production at large transverse momentum in $\pi^- p$, $\pi^+ p$ and pp collisions at 300 GeV/c. De Marzo, C.; De Palma, M.; Favuzzi, C.; Maggi, G.; Nappi, E.; Posa, F.; Ranieri, A.; Selvaggi, G.; Spinelli, P.; Bamberger, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik; Istituto Nazionale di Fisica Nucleare, Bari (Italy); Freiburg Univ. (Germany, F.R.)). Dec 1986. 16p. NTIS, PC E07; Available from NTIS as TIB/B87-05916.

Cross sections for inclusive π^0-production at large transverse momentum, p/sub T/, were measured in $\pi^- p$, $\pi^+ p$ and pp collisions at 300 GeV/c. The cross section ratio $\sigma(\pi^- p \geqq \pi^0 X)/\sigma(\pi^+ p \geqq \pi^0 X)$ was found to be consistent with unity in the p/sub T/ region of 1 to 5 GeV/c. The cross section ratio $\sigma(\pi^+ p \geqq \pi^0 X)/\sigma(pp \geqq \pi^0 X)$ however is growing with increasing pT and increasing π^0 c.m.s. rapidity in agreement with parton model expectations, where the partons in the pions have on average higher momenta than in the proton.

35979 (OUP—87-01) Measurements of the charmonium P-states and the eta-c into 2 gammas at the ISR. Buran, T. (Oslo Univ. (Norway). Fysisk Inst.). Jan 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752185.

Talk given at Nuclear Physics Laboratory, University of Oxford, 8 May 1986.

A review of the experiment R704 at CERN ISR is given. Charmonium states are formed using stored antiprotons on an internal gas jet target. Results on mass, total widths and coupling to anti pp are presented for the chi/sub 1/ and chi/sub 2/ states. A new upper limit to the $\gamma\gamma$ decay of the eta/sub c/ and a search for the P/sub 1/ state are discussed.

35980 (SLAC-PUB—4281) Bounds on neutrino masses from particle physics and cosmology. Nir, Y. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); Weizmann Inst. of Science, Rehovoth (Israel)). Mar 1987. Contract AC03-76SF00515. 7p. (CONF-8703121—3). NTIS, PC A02. File Number DE87009449.

From Telemark IV - neutrino mass and neutrino astrophysics; Ashland, WI, USA (16 Mar 1987).

We study the constraints imposed on the masses of nu/sub e/, nu/sub μ/ and nu/sub tau/ on the basis of direct experimental bounds, cosmological bounds, theoretical calculations of neutrino decay rates, experimental bounds on related decays of charged leptons and the structure of neutrino mass matrices in the "see-saw" mechanism. We consider standard model amplitudes as well as contributions from all "beyond standard" models. Assuming a simple "reasonable" form of the see-saw mechanism, we derive the bounds: m(nu/sub tau/) $\leqq$ 65 eV, m(nu/sub μ/) $\leqq$ 4 eV, m(nu/sub e/) $\leqq$ 0.02 eV, M(W/sub R/) $\geqq$ 50 PeV.

35981 (SLAC-PUB—4284) Neutrino counting in $e^+ e^-$ annihilation. Burke, D.L. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Mar 1987. Contract AC03-76SF00515. 45p. (CONF-8606259—6). NTIS, PC A03/MF A01; GPO Dep. File Number DE87010546.

From Theoretical Advanced Study Institute conference; Santa Cruz, CA, USA (23 Jun 1986).

The physics that can be learned from studies of $e^+ e^- \rightarrow \gamma +$ weakly interacting particles is examined. It is shown that the physics probed by this reaction depends greatly upon the energy at which experiments are done. The experimental techniques used for these studies are emphasized, particularly the central problem of electromagnetic calorimetry. The present status of knowledge of single-photon production is presented, with a detailed look at the ASP experiment at PEP and the physics interpretation of the results of that experiment. A look at how experiments will be done at the next generation of $e^+ e^-$ machines SLC and LEP is given, and the importance of making a precise measurement of the cross section events accompanied by initial-state radiation of a single, hard photon at center of mass energies near the mass of Z^0 is examined. (LEW)

35982 (SLAC-PUB—4332) Recent measurements of the average lifetime of hadrons containing B-quarks from PEP experiments at SLAC [Stanford Linear Accelerator Center]. Camporesi, T. (European Organization for Nuclear Research, Geneva (Switzerland); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). May 1987. Contract AC03-76SF00515. 4p. (CONF-870390—7). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011596.

From 22. Recontres de Moriond: electroweak interactions and unified theories conference; Les Arcs, France (8 Mar 1987).

Recent precise results from several experiments have confirmed the early evidence that the lifetime of hadrons containing B-quarks is rather long, implying that the third generation of quarks is more decoupled from the first two than the second is from the first. The average of the measurements performed by the experiments at PEP is 1.08 +- 0.13 ps.

35983 (TRI-PP—87-19) Different contributions to the anomalous magnetic moment of the W-boson. Couture, G. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 5p. (CONF-870279—7). NTIS (US Sales Only), MF A01. File Number DE87900668.

From Lake Louise winter institute; Alberta, Canada (15 Feb 1987).

We present some limits on the anomalous magnetic moment of the W-boson. The calculation is first performed in the Standard Model context, then extended to a two-Higgs-doublet model. The main result is that a deviation of 20% from the tree level value would be very difficult to accommodate in any weakly interacting, renormalizable model.

35984 Inclusive cross section ratios in high p/sub T/ proton-proton scattering at ISR energies. Breakstone, A.; Crawley, H.B.; Firestone, A.; Gorbics, M.; Isenhower, D.; Lamsa, J.W.; Meyer, W.T.; Campanini, R.; Cuffiani, M.; Deninno, M.M. (Ames Lab., IA, USA; Iowa State Univ. of Science and Technology, Ames, USA. Dept. of Physics). *Zeitschrift fuer Physik [Sektion] C: Particles and Fields;* **35**: No. 2, 158-165(Jun 1987). Contract AC03-76SF00098.

Ratios of inclusive cross sections $\sigma(\pi/\text{sup} +/)/\sigma(\pi/\text{sup} +/ + \text{K/sup} +/ + \text{p})$ and $\sigma(\pi/\text{sup} -/)/\sigma(\pi/\text{sup} -/ + \text{K/sup} -/\text{anti p})$ were measured for proton-proton interactions with a high p/sub T/ hadron in the final state around c.m.s. scattering angles $\theta \cong$ 10/sup 0/, 20/sup 0/ and 45/sup 0/ at two ISR energies $\sqrt{s}$ = 31 GeV and 62 GeV. Results are shown as functions of transverse and longitudinal momentum and are compared with parton model predictions. The different dependences of positive and negative pion fractions at p/sub T/ $\cong$ 2-3 GeV/c on longitudinal momenta is similar to that observed in soft hadronic interactions at low values of p/sub T/ where the leading proton effect (diquark fragmentation) is known to contribute. The quantitative agreement of the data with diquark model predictions indicates the presence of diquark fragmentation also in high p/sub T/ jets.

35985 **Production of neutral pions from 200 GeV πp p collisions in the high chi region.** Kennett, R.G.; Barnes, A.V.; Fox, C.G.; Walker, R.L.; Dahl, O.I.; Kenney, R.W.; Ogawa, A.; Pripstein, M. (California Institute of Technology, Pasadena; Lawrence Berkeley Lab., CA). *Nuclear Physics [Section] B;* **284**: No. 3/4, 653-673(13 Apr 1987). Contract AC03-81ER40050.

We present data from the Caltech-LBL experiment at Fermilab using a photon detector to study π^0 production from a 200 GeV π^- beam. We present cross sections for inclusive π^0 production with $0 < -t < 8$ GeV^2 and for π^0 production with an all-neutral final state for $0 < -t < 6$ GeV^2, both with π^0 energies above 100 GeV. The chi-dependences of the cross sections agree with the predictions of the triple Regge model and are used to derive a rho trajectory. Our new data are compared to earlier results using a 100 GeV beam over a more limited energy and momentum transfer regime.

35986 **Results from the IMB detector the Irvine-Michigan-Brookhaven collaboration.** Bionta, R.M.; Blewitt, G.; Bratton, C.B.; Cortez, B.G.; Errede, S.; Foster, G.W.; Gajewski, W.; Goldhaber, M.; Greenberg, J.; Haines, T.J. (The Univ. of Michigan, Ann Arbor, MI 48109). pp 46-68 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—).

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

Results are presented from the first 80 days of the IMB detector, with 69 observed interactions in a 3300 metric ton fiducial volume. The 69 events are consistent with atmospheric neutrinos. Limits are set at the 90% CL for the lifetime/branching ratio tau/B for rho $\rightarrow$ e/sup $+/\pi^0$ at 6.5 x 10/sup 31/ years and rho $\rightarrow$ μ/sup $+/K^0$ at 1.4 x 10/sup 31/ years. For n $\rightarrow$ n/sup -/, in oxygen, the lifetime is tau $>$ 7 x 10/sup 30/ years. Limits on monopole catalysis of nucleon decay up to a flux of 10/sup -14//cm/sup 2/ sec sr are described.

35987 **New results from the Soudan 1 detector.** Peterson, E. pp 35-45 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—).

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

The Soudan 1 detector began operation in May 1981, and has produced reliable data since October 1981. The authors present here results (preliminary in some cases) from three classes of data that have been obtained, on nucleon decay, magnetic monopoles and multiple-muon events.

35988 **Neutrino mass and neutrino oscillations.** Boehm, F. (California Institute of Technology). pp 163-173 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—).

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

The authors review the present status of neutrino mass as it emerges from spectroscopic measurements and neutrino oscillation experiments.

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REFER ALSO TO CITATION(S) 35967, 36026, 36027, 36037

35989 **(BNL—39658) Charged current unitarity and extra neutral gauge bosons.** Marciano, W.J.; Sirling, A. (Brookhaven National Lab., Upton, NY (USA); New York Univ., NY (USA). Dept. of Physics). Mar 1987. Contract AC02-76CH00016. 8p. (CONF-870121—7). NTIS, PC A02/MF A01. File Number DE87010049.

From Meeting of the Division of Particles and Fields of the American Physical Society; Salt Lake City, UT, USA (14 Jan 1987).

The experimental status of the Kobayashi-Maskawa-Cabibbo (KMC) matrix is surveyed and shown to provide a precision test of the standard model at the level of its $O(\alpha)$ radiative corrections. Implications for new physics and constraints of extra neutral gauge bosons are described. 12 refs., 1 fig.

35990 **(BNL—39675) Resonant solar neutrino oscillation versus laboratory neutrino oscillation experiments.** Lim, Chong-Sa. (Brookhaven National Lab., Upton, NY (USA)). Feb 1987. Contract AC02-76CH00016. 10p. (CONF-870283—6). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010048.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

The interplay between resonant solar neutrino oscillations and neutrino oscillations in laboratory experiments is investigated in a 3 generation model. Due to the assumed hierarchy of neutrino masses, together with our choice of a convenient parameterization of the 3 generation mixing matrix, we can derive a simple analytic formula which reduces the solar neutrino problem to an effective 2 generation problem. The reduction makes it apparent that the allowed range of mixing and mass parameters crucially depend on whether the survival probability of solar neutrinos S satisfies S $\geqq$ 1/3 or not. The formulae for probabilities of laboratory neutrino oscillations are also greatly simplified. We argue that a combination of the observed solar neutrino depletion and data obtained from reactor experiments seems to rule out some range of neutrino masses. If a sizable nu/sub μ/ $\rightarrow$ nu/sub e/ oscillation is observed at accelerators, as suggested at this Workshop, it severely restricts the range of 2 mixing angles.

35991 **(BNL—39727) Neutrino physics: A theoretical perspective.** Marciano, W.J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 13p. (CONF-870283—4). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010061.

From BNL neutrino workshop; Upton, NY, USA (5 Feb 1987).

Experimental measurements of sin^{2}theta/sub W/ are surveyed. They are shown to test electroweak unification at the quantum loop level and constrain new physics beyond the standard model. Neutrino oscillations are also examined in the framework of 3 generation mixing. Searches for nu/sub μ/ $\rightarrow$ nu/sub tau/ oscillation at aceelerator facilities are advocated.

35992 **(BNL—39764) Toward a pseudofermion calculation of the hadronic mass spectrum.** Campostrini, M.; Moriarty, K.J.M.; Potvin, J.; Rebbi, C. (Brookhaven National Lab., Upton, NY (USA); Istituto Nazionale di Fisica Nucleare, Pisa (Italy); Dalhousie Univ., Halifax, Nova Scotia (Canada); Boston Univ., MA (USA)). Feb 1987. Contract AC02-76CH00016. 14p. (CONF-8609142—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010441.

From Lattice gauge theory meeting; Upton, NY, USA (15 Sep 1986).

We present our preliminary results of a pseudofermion simulation of QCD, on a $10^3 \cdot 32$ lattice at $\beta = 5.7$. The fermions are of the Kogut-Susskind type (3 flavors) with mass ma $= 0.05$. It is found that the hadron propagators take more than 10000 Metropolis iterations to equilibrate, a factor 5 more than what is needed in a typical quenched calculation. We present also our results on the effects of dynamical quarks on the Wilson loops.

35993 **(DESY-L-Trans—316) Semileptonic decays of charmed baryon in the phenomenological chiral Lagrangian method.** Kalinovskij, Yu.L.; Sarikov, N.A.; Takhtamyshev, G.G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Gomel'skij Politekhnicheskij Inst. (Byelorussian SSR); AN Uzbekskoj SSR, Tashkent. Inst. Yadernoj Fiziki; Joint Inst. for Nuclear Research, Dubna (USSR)). Dec 1986. 5p. NTIS, PC E07; Available from NTIS as TIB/B87-05872.

Translated from Russian; originally published as JINR-P2—86-365.

The probabilities of the semileptonic decays of charmed baryons λ/sub c/$^+$ (λ/sub c/$^+$ -> $1/2^+$/sub ϵ+nu/) have been calculat-

ed in the framework of the chiral Lagrangian method generalized by including interactions of spin-1 mesons with 1/2$^+$-baryons and O/sup -/mesons. It is shown that the dominant decay is a Cabibbo-favoured one λ/sub c/$^+$ -> λe nu with the decay probability being in agreement with the experimentally found partial width of the inclusive decay λ/sub c/$^+$ -> λ eX.

35994 **(DOE/ER/05126—310) Roper resonance in a color dielectric model.** Broniowski, W.; Cohen, T.D.; Banerjee, M.K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Oct 1986. Contract AS05-76ER05126. 18p. (ORO—5126-310; PP—87-096). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87007377.

Radial excitations of baryons are studied in the framework of a color dielectric model. An analogue of the RPA technique is used to describe coupled vibrations of valence quarks and the background "glueball" field. The excitation energy of the Roper resonance is found to be in the range 300 to 350 MeV. It is also established that the solitons in the color dielectric model are classically stable with respect to radial vibrations.

35995 **(DOE/ER/40048—06-P7) Closed string in the proper-time gauge.** Lee, T. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 30p. NTIS, PC A03. File Number DE87011079.

A quantization of the closed string in the proper-time gauge which ensures manifest covariance, is discussed. This is an extension of previous work for open bosonic string. The Polyakov string propagator evaluated in the proper-time gauge already exhibits the correct structure of the action for second quantized closed bosonic string, which is BRST invariant. A geometrical explanation for the proper-time gauge conditions as an appropriate gauge fixing condition is presented. We also evaluate the BRST invariant one loop string path integral. 32 refs.

35996 **(DOE/ER/40048—07-P7) Open bosonic string in the proper-time gauge.** Lee, T. (Washington Univ., Seattle (USA). Dept. of Physics). May 1987. Contract AC06-81ER40048. 30p. NTIS, PC A03/MF A01; GPO Dep. File Number DE87011077.

A path integral formulation of the first quantization of an open bosonic string in the proper-time gauge is discussed. The string propagator given by a path integral a la Polyakov, is evaluated in the proper-time gauge. The evaluated propagator uniquely determines the action for the free string field in the second quantized theory. The BRST invariant action for a free bosonic string field proposed by Siegel is shown to emerge naturally. 39 refs.

35997 **(DOE/ER/40125—T1) Four preon composite quarks and leptons.** Rajpoot, S.; Samuel, M.A. (Oklahoma State Univ., Stillwater (USA). Dept. of Physics). Jan 1987. Contract AC02-84ER40125. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009609.

A model is presented in which quarks and leptons are composites of three spin-1/2 preons and a scalar preon. The model is an extension of the rishon model and consists of two spin-1/2 preons T,V and a scalar preon S as the fundamental building blocks of matter. Assuming distinguishability of states due to the order assigned to the preons in forming the quark and lepton states, the concepts of flavour, colour and generation number acquire meaning only at the level of compositeness. The model predicts four generations of conventional quarks and leptons.

35998 **(LBL—23038) The quest for the Higgs boson.** Hinchliffe, I. (Lawrence Berkeley Lab., CA (USA)). Feb 1987. Contract AC03-76SF00098. 21p. (CONF-870279—3). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009160.

From Lake Louise winter institute; Alberta, Canada (15 Feb 1987).

Various ways are reviewed which have been suggested to search for the Higgs boson of the Weinberg-Salam model. It is found that if the Higgs mass is less than 40 GeV or so, it should be found in the decay of the Z either at the SLC or at LEP. Masses larger than this can be probed in the decay of toponium, if toponium exists in an accessible mass range. 27 refs., 15 figs. (LEW)

35999 **(LBL—23108) A fresh look at Bose-Einstein correlations.** Hofmann, W. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 21p. (CONF-870165—4). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009156.

From Workshop on electronuclear physics with internal targets; Stanford, CA, USA (5 Jan 1987).

Recent experimental data on Bose-Einstein (BE) correlations between identical bosons are reviewed, and new results concerning the interpretation of the BE enhancement are discussed. In particular, it is emphasized that the classical interpretation of the correlation function in terms of the space-time distribution of particle production points cannot be directly applied to particle production in high energy reactions.

36000 **(OUP—87-05) Recoil corrected bag model calculations for semileptonic weak decays.** Lie-Svendsen, Oe.; Hoegaasen, H. (Oslo Univ. (Norway). Fysisk Inst.). Feb 1987. 39p. NTIS (US Sales Only), PC A03/MF A01. File Number DE87752188.

Recoil corrections to various model results for strangeness changing weak decay amplitudes have been developed. It is shown that the spurious reference frame dependence of earlier calculations is reduced. The second class currents are generally less important than obtained by calculations in the static approximation. Theoretical results are compared to observations. The agreement is quite good, although the values for the Cabibbo angle obtained by fits to the decay rates are somewhat to large. 21 refs.

36001 **(PITHA—86/09) Photon photon reactions.** Berger, C.; Wagner, W. (Technische Hochschule Aachen (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 1986. 193p. (UCD—86/26). NTIS, PC E14; Available from NTIS as TIB/B87-00399.

The particle production by photon-photon interactions is reviewed. After a description of the kinematics of such processes the production of resonances is considered. Then nonresonant exclusive interactions are discussed. Finally the inclusive production is considered whereby some experimental results on such processes are presented. (HSI).

36002 **(PITHA—86/10) Secondary leptons in b anti b jets: Role of two-body decays of B-mesons.** Sehgal, L.M.; Wanninger, M. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). May 1986. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-01534.

Secondary muons produced in the cascade b -> c -> μ/sup +/ can contribute to the like sign dimuons observed in p anti p -> b anti b -> μμX. An estimate of this source requires knowledge of the inclusive spectrum of D mesons produced in nonleptonic B decay, usually simulated by the quark decay matrix element b -> canti ud. We argue that two-body decay modes (B -> Drho, B -> DF etc.) produce a significantly harder D meson spectrum, leading to an enhancement of the like-sign dimuon rate. The enhancement factor is ξf/sub 2/ + f/sub n/, where f/sub 2/ and f/sub n/ are the two-body and multi-body decay fractions, and ξ ≃ 1.5 for UA1 conditions. We examine the energy partition between secondary muon and accompanying hadrons, and find that muons of two-body origin are more 'isolated'.

36003 **Diffractive hard scattering.** Berger, E.L.; Collins, J.C.; Soper, D.E.; Sterman, G. (Argonne National Lab., IL; Illinois Institute of Technology, Chicago; Oregon Univ., Eugene; State Univ. of New York, Stony Brook; Institute for Advanced Study, Princeton, NJ). *Nuclear Physics [Section] B;* **286**: No. 3/4, 704-728(11 May 1987). Contract W-31-109-ENG-38.

From 21. Rencontre de Moriond: strong interactions and gauge theories conference; Les Arcs, France (16 Mar 1986).

Also published as report ANL-HEP-CP—86-52; CONF-8603119—11.

We discuss high energy hadron collisions that contain a hard scattering, in the sense that a W, a Z, very heavy quarks, or high p/sub T/ jets are produced, yet are diffractive, in the sense that

one of the incident hadrons is scattered with only a small energy loss. In our approach, the cross section for such diffractive hard scattering is a part of the normal hard scattering inclusive cross section, as calculated using perturbative quantum chromodynamics. We use Regge phenomenology in combination with perturbative QCD to estimate that a substantial fraction (perhaps 30%) of all hard scattering events are diffractive. Measurement of diffractive hard scattering cross sections would illuminate the short distance gluon and quark content of the pomeron, which has been found to play a fundamental role in forward hadron scattering.

36004 **Weak interaction matrix elements with staggered fermions. Part. 1. Theory and a trial run.** Sharpe, S.R.; Patel, A.; Gupta, R.; Guralnik, G.; Kilcup, G.W. (Washington Univ., Seattle; California Univ., San Diego, La Jolla; Los Alamos National Lab., NM; Harvard Univ., Cambridge, MA). *Nuclear Physics [Section] B;* **286**: No. 2, 253-292(4 May 1987). Contract AS03-81ER40029;AC02-76ER03130;AC06-81ER40048.

We present results of a preliminary study of the matrix elements of weak interaction opertors using staggered fermions. We describe our method for transcribing the weak interaction hamiltonian onto the lattice. This method preserves exact Ward identities analogous to those of the continuum. The calculation uses operators involving 0, 1, 2, 3, and 4 gauge links. We present results for all these operators obtained on 8/sup 3/x16 lattices generated both with the Wilson action (β=5.6) and an improved action.

36005 **Large scale simulations of the thermodynamics of quantum chromodynamics.** Kogut, J.B.; Sinclair, D.K. (Illinois Univ., Urbana, USA. Dept. of Physics; Argonne National Lab., IL, USA. High Energy Physics Div.). *Nuclear Physics B, Field Theory Statistical Systems;* **280**: No. 4, 625-643(27 Apr 1987).

Hybrid stochastic and microcanonical logarithms are applied to simulate SU(3) lattice gauge theory with four species of dynamical, light quarks. Lattices of size 6 x 10/sup 3/ and bare quark masses ranging from m=0.250 down to 0.050 (in lattice units) are employed to study the character of the transition from hadronic matter to the quark-gluon plasma. Metastability studies suggest that as the bare quark mass decreases the transition changes from strongly first order at m=0.250 to an abrupt crossover at m=0.050. The temperature of the crossover region is found to be T/Λ sub(anti MS)=2.14 +- 0.10 and should be accessible to planned heavy ion experiments.

36006 **Axion and familons.** Chang, D.; Senjanovic, G. (Northwestern Univ., Evanston, IL; Brookhaven National Lab., Upton, NY). *Physics Letters [Section] B;* **188**: No. 2, 231-235(9 Apr 1987).

We study the connection between the global family symmetry G/sub F/=SU(N) and Peccei-Quinn symmetry U(1)/sub PQ/ in the context of SO(10). It turns out that GF automatically leads to U(1)/sub PQ/, if the Higgs representation is properly restricted. This implies that the decay $K^+ \to \pi^+$ + no[thing (Goldstone boson) should be observable soon. Furthermore, for odd number of families, the theory is free from the axionic domain wall problem. Finally, if B-L breaking is tied to G/sub F/ and U(1)/sub PQ/ breaking, the theory favors three families of fermions.

36007 **Two-particle-inclusive cross section in e^+e^- annihilation at PETRA, PEP and LEP energies.** Collins, J.C.; Soper, D.E. (Illinois Institute of Technology, Chicago; Argonne National Lab., IL; Oregon Univ., Eugene). *Nuclear Physics [Section] B;* **284**: No. 2, 253-270(6 Apr 1987). Contract W-31-109-ENG-38.

We compare QCD theory with PLUTO and CELLO experimental results for the energy correlation function in e^+e^- annihilation. We also present expectations for this function at 94 GeV c.m. energy at SLC and LEP.

36008 **Heavy fermion production in the effective W approximation.** Dawson, S.; Willenbrock, S.S.D. (Lawrence Berkeley Lab., CA; Texas Univ., Austin). *Nuclear Physics [Section] B;* **284**: No. 2, 449-462(6 Apr 1987). Contract AC03-76SF00098;FG05-85ER40200.

We examine heavy fermion production in the effective W approximation. The rate for heavy quark production via W-gluon fusion is calculated in the effective W approximation and excellent agreement is found with the exact calculation. We also consider heavy lepton production from gauge boson fusion and compare it with the contribution from the Drell-Yan mechanism and from gluon fusion.

36009 **Production of exotic E_6 leptons in ep collisions.** Rizzo, T.G. (Ames Lab., IA; Iowa State Univ. of Science and Technology, Ames). *Physics Letters [Section] B;* **188**: No. 1, 95-98(2 Apr 1987). Contract W-7405-ENG-82.

We consider the possibility of producing single, charged E_6 exotic leptons in ep collisions at high energies via flavor-changing couplings to neutral gauge bosons. We find that at HERA energies the production rate for these particles is quite small due to small mixing effects. At higher energies, as may be possible at a LEP ep collider, the production rates become reasonably large: $\simeq$ 100-1000 events per year.

36010 **Quark and lepton flavor violating Z^0 decays in E_6.** Eilam, G.; Rizzo, T.G. (Ames Lab., IA; Iowa State Univ. of Science and Technology, Ames). *Physics Letters [Section] B;* **188**: No. 1, 91-94(2 Apr 1987). Contract W-7405-ENG-82.

Appreciable lepton flavor violating decays of Z^0, e.g. $Z^0 \to$ μtau, can occur in E_6 grand unified theories. We examine these decays and find, using the existing experimental limits on rare processes, that some may have branching ratios as large as a few times 10^{-4}. Flavor violating quark decays are also expected at the same level but only in the Q = -1/3 sector (e.g. $Z^0 \to$ banti s, but Z^0 not = tanti c) within the framework of E_6; these quark decays are very difficult to observe experimentally.

36011 **Limits on neutrino oscillation parameters from the chlorine solar-neutrino experiment.** Cribier, M.; Rich, J.; Spiro, M.; Vignaud, D.; Hampel, W.; Cleveland, B.T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France; Max-Planck-Institut fuer Kernphysik, Heidelberg, Germany, F.R.; Los Alamos National Lab., NM). *Physics Letters [Section] B;* **188**: No. 1, 168-170(2 Apr 1987).

MSW regeneration of solar nu/sub e/ in the earth can lead to a seasonal variation in the capture rate in the chlorine solar-neutrino experiment. The absence of such an effect in the data allows us to set a limit on the neutrino oscillation parameters for Δm^2 near 3×10^{-6} eV^2. The limit thus obtained is only weak dependent on solar-model inputs.

36012 **Fits to high energy pp and anti pp total cross sections and rho values.** Block, M.M.; Cahn, R.N. (Northwestern Univ., Evanston, IL; Lawrence Berkeley Lab., CA). *Physics Letters [Section] B;* **188**: No. 1, 143-148(2 Apr 1987). Contract AC03-76SF00098;AC02-76ER02289.

The Spanti pS data for scattering at 900 GeV are included in fits to the pp and panti p total cross sections and rho values. Fit that are asymptotically constant as well as ones that grow asymptotically as log^2(s/s/sub 0/) are considered. The sensitivity of the fits to the inclusion of lower energy data (5 GeV $< \sqrt{s} <$ 15 GeV) is analyzed. The relation between these fits and ones of the Amaldi-type, with s/sub 0/ = 1 GeV^2 is clarified.

36013 **Monopoles, gauge fields, and anomalies.** Goldhaber, A.S. (Institute for Theoretical Physics, State Univ. of New York at Stony Brook, Stony Brook, Long Island, NY 11794). pp 115-120 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—).

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

The possible catalysis of baryon disintegration by magnetic poles is a beautiful example of the way in which monopoled illuminate fundamental concepts of physics. This hypothetical process is followed step by step, with an effort to minimize arbitrary hypotheses and to state clearly those which remain, as well as the consequences of changing them. The conclusions are that there should be

a large cross section for catalysis in collisions of slow monopoles with nucleons, though not with large nuclei, but the intrinsic rate for destruction of a nucleon captured by a pole could be many orders of magnitude below the 10/sup 23/ per second which characterizes strong interactions. It is argued that Rubakov's and Callan's pictures of catalysis are compatible but distinct, and either permits a strong rate, but requires at least a weak rate.

36014 **Atmospheric neutrinos and astrophysical neutrinos in proton decay experiments.** Dar, A. (Dept. of Physics, Univ. of Pennsylvania, Philadelphia, PA 19104). pp 101-114 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—).

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

The authors present simple analytical estimates of the fluxes of atmospheric and interstellar neutrinos. They show that the geomagnetic cutoff strongly suppresses the fluxes of atmospheric neutrinos below 1 GeV from directions of low magnetic latitudes and may open a window for neutrino astronomy. They demonstrate the validity of their estimates through indirect tests.

6453 Particle Invariance Principles And Symmetries

36015 **(DOE/ER/40272—22) The explicit gauge invariance of the free closed bosonic strings and open fermionic string.** Ramond, P.; Rodgers, V.G.J.; Viswanathan, R.R. (Florida Univ., Gainesville (USA). Dept. of Physics). 1986. Contract FG05-86ER40272. 39p. (UFTP—86-22). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008767.

We derive the gauge invariant equations of motion for the open Ramond superstring and closed string theories. We show that the actions which give the equations of motion for all the closed string theories are quite similar in form and require the introduction of an auxiliary field.

36016 **Critical surfaces and flat directions in a finite theory.** Rabinovici, E.; Saering, B.; Bardeen, W.A. (CERN, CH-1211 Geneva 23, Switzerland). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 2, 562-567(15 Jul 1987).

We discuss the phase structure of an O(N) x O(N)-symmetric model with scalar fields in three-dimensional space-time. The effective potential of the theory is calculated in the large-N limit and stability conditions for the model are given. Spontaneous breaking of scale invariance due to the breakdown of the internal symmetry or to nonperturbative mass generation is observed on a critical surface, in connection with the appearance of flat directions in the effective potential. The ground-state energy of the model remains unchanged under the transition from the scale-invariant phase to the various phases, where scale invariance is spontaneously broken. The critical surface allows for arbitrary ratios between the scales associated with breaking of the internal and scale symmetries.

36017 **Conformal anomalies and the index theorem.** Alvarez, O. (California Univ., Berkeley; Lawrence Berkeley Lab., CA). *Nuclear Physics* [*Section*] *B;* **286**: No. 1, 175-188(20 Apr 1987). Contract AC03-76SF00098.

In some two-dimensional field theories, the family index theorem can be used to calculate the conformal anomaly. This is surprising since there is no known underlying topological origin for the conformal anomaly. The index theorem approach provides a different way of understanding Friedan's theorem relating the conformal anomaly to the Virasoro charge. Various aspects of string models are discussed within the context of the index theorem.

6454 Field Theory

REFER ALSO TO CITATION(S) 35923, 35967, 35988, 36005, 36013, 36016

36018 **(BNL—39781) Chiral field theories as models for hadron substructure.** Kahana, S.H. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 9p. (CONF-8703136—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010439.

From Elementary structure of materials; Les Houches, France (24 Mar 1987).

A model for the nucleon as soliton of quarks interacting with classical meson fields is described. The theory, based on the linear sigma model, is renormalizable and capable of including sea quarks straightforwardly. Application to nuclear matter is made in a Wigner-Seitz approximation.

36019 **(BNL—39787) Experimenting with Langevin lattice QCD.** Gavai, R.V.; Potvin, J.; Sanielevici, S. (Brookhaven National Lab., Upton, NY (USA)). May 1987. Contract AC02-76CH00016. 11p. (CONF-8609142—5). NTIS, PC A02. File Number DE87010438.

From Lattice gauge theory meeting; Upton, NY, USA (15 Sep 1986).

We report on the status of our investigations of the effects of systematic errors upon the practical merits of Langevin updating in full lattice QCD. We formulate some rules for the safe use of this updating procedure and some observations on problems which may be common to all approximate fermion algorithms.

36020 **(BONN-HE—86-30) On the identification of finite operator algebras in two-dimensional conformally invariant field theories.** Christe, P.; Flume, R. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Oct 1986. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-01477.

We investigate the structure of the linear differential operators whose solutions determine the four point correlations of primary operators in the d=2 conformally invariant SU(2) σ-model with Wess-Zumino term and the d=2 critical statistical systems with central Virasoro charge smaller than one. Factorisation properties of the differential operators are related to a finite closure of the operator algebras. We recover the selection and fusion rules of Fateev, Zamolodchikov and Gepner, Witten for the SU(2) σ-model. It is outlined how the results of the SU(2) model can be used for the identification of closed operator algebras in the statistical model.

36021 **(LBL—23028) The geometry of continuum regularization.** Halpern, M.B. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 9p. (CONF-870151—2). NTIS, PC A02. File Number DE87008230.

From Irvine conference on non-perturbative methods in field theory; Laguna Beach, CA, USA (7 Jan 1987).

This lecture is primarily an introduction to coordinate-invariant regularization, a recent advance in the continuum regularization program. In this context, the program is seen as fundamentally geometric, with all regularization contained in regularized DeWitt superstructures on field deformations.

36022 **(LBL—23148) Continuum regularization of gauge theory with fermions.** Chan, H.S. (Lawrence Berkeley Lab., CA (USA)). Mar 1987. Contract AC03-76SF00098. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. File Number DE87010281.

The continuum regularization program is discussed in the case of d-dimensional gauge theory coupled to fermions in an arbitrary representation. Two physically equivalent formulations are given. First, a Grassmann formulation is presented, which is based on the two-noise Langevin equations of Sakita, Ishikawa and Alfaro and Gavela. Second, a non-Grassmann formulation is obtained by regularized integration of the matter fields within the regularized Grassmann system. Explicit perturbation expansions are studied in both formulations, and considerable simplification is found in the integrated non-Grassmann formalism.

36023 **(SLAC-PUB—4136) Non-linear σ-models and string theories.** Sen, A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1986. Contract AC03-76SF00515. 17p. (CONF-8606312—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87003268.

From Summer workshop on high energy physics and cosmology; Trieste, Italy (30 Jun 1986).

The connection between σ-models and string theories is discussed, as well as how the σ-models can be used as tools to prove

various results in string theories. Closed bosonic string theory in the light cone gauge is very briefly introduced. Then, closed bosonic string theory in the presence of massless background fields is discussed. The light cone gauge is used, and it is shown that in order to obtain a Lorentz invariant theory, the string theory in the presence of background fields must be described by a two-dimensional conformally invariant theory. The resulting constraints on the background fields are found to be the equations of motion of the string theory. The analysis is extended to the case of the heterotic string theory and the superstring theory in the presence of the massless background fields. It is then shown how to use these results to obtain nontrivial solutions to the string field equations. Another application of these results is shown, namely to prove that the effective cosmological constant after compactification vanishes as a consequence of the classical equations of motion of the string theory. 34 refs. (LEW)

36024 **(TRI-PP—87-17) Phenomenology of extra Z's in E_6 theories.** London, D.; Belanger, G.; Ng, J.N. (TRIUMF, Vancouver, British Columbia (Canada)). Feb 1987. 6p. (CONF-870279—8). NTIS (US Sales Only), PC A02. File Number DE87900667.

From Lake Louise winter institute; Alberta, Canada (15 Feb 1987).

We consider the effects of Z^0-Z' mixing, where the Z' is an E_6 gauge boson, on processes which will be measured at e^+e^- colliders. Using constraints from neutral current data and measurements of the W and Z masses, we find that significant mixing may be allowed. This mixing leads to measurable changes in the Z^0 partial widths and $\sigma(e^+e^- \to \mu^+\mu^-)$. In one case, we also find that a Z' lighter than the Z^0 is still allowed. We discuss possibilities for its detection. We also consider the effects of the Z' in nu/sub e/e and anti nu/sub μ/e scattering experiments. We find that effects larger than 1% or 2% could be present even in the presence of small Z^0-Z' mixing. Neutrino scattering and e^+e^- collider experiments give complementary information on the properties of the Z'.

36025 **Light-fermion-mass generation in a Kaluza-Klein theory.** Carter, M.R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 and Department of Physics, Stanford University, Stanford, California 94305). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 2, 412-425(15 Jul 1987).

I study a model of a compactified Kaluza-Klein theory as an SU(2) gauge theory on the direct product of a flat two-dimensional Minkowski space M^2 with a two-sphere S^2. The perturbation theory on M^2 is developed. In particular, induced tree-level fermion-gauge field and one-loop fermion—Higgs-boson Yukawa couplings are computed. The latter calculation generates a mass hierarchy for the massless fermions on M^2.

36026 **Factorization and zero-slope limit of strings.** Itoyama, H. (Fermi National Accelerator Laboratory, P.O. Box 500, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **36**: No. 2, 480-488(15 Jul 1987).

Factorization properties of open strings are studied and the zero-slope limit of tachyon emission is discussed from this point of view. The generating functional for the S-matrix element is constructed and is shown to obey, in the zero-slope limit, the same functional equation as the one of phi^3 field theory. Comments on the relation to recent approaches are made.

36027 **Spin dependent potential for heavy fermions on the ends of a string.** Pisarski, R.D.; Stack, J.D. (Fermi National Accelerator Lab., Batavia, IL; Illinois Univ., Urbana). *Nuclear Physics* [*Section*] *B;* **286**: No. 3/4, 657-668(11 May 1987).

Mesons with heavy quarks are modeled by putting fermions on the ends of a string. The spin dependence of the fermion potential over large distances is found by solving for the classical motion of a rotating string. Some general remarks about such theories of heavy strings are also made.

36028 **Correlation functions of spin operators on a torus.** Atick, J.J.; Sen, A. (Stanford Univ., CA). *Nuclear Physics* [*Section*] *B;* **286**: No. 1, 189-210(20 Apr 1987). Contract AC03-76SF00515.

An expression for the arbitrary n-point correlation function of SO(2) spin operators on a torus is derived. From this expression one can calculate the n-point correlation function of any SO(2N) spin operators. Application of our results to the calculation of one-loop scattering amplitudes involving SO(16) and SO(10) spin fields in superstring theories is also given.

36029 **Anomaly of D/sub μ/J/sup μ/ from the Schwinger terms.** Hwang, D.S. (Lawrence Berkeley Lab., CA). *Nuclear Physics* [*Section*] *B;* **286**: No. 1, 231-244(20 Apr 1987). Contract AC03-76SF00098.

We first derive a classical relation $d_0G/\text{sub a/} = (D/\text{sub } \mu/J/\text{sup } \mu/)/\text{sub a/}$. Then we calculate the quantum version of this relation in two dimensions. This procedure provides a method of obtaining the anomaly of D/sub μ/J/sup μ/ (chiral current) from the Schwinger terms of the equal time commutation relations. By this consideration we can also understand easily the difficulties in quantizing anomalous gauge theories.

36030 **Dilaton classical solution and the supersymmetry breaking evolution in an expanding universe.** Antoniadis, I.; Kounnas, C. (Stanford Linear Accelerator Center, CA; California Univ., Berkeley; Lawrence Berkeley Lab., CA). *Nuclear Physics* [*Section*] *B;* **284**: No. 3/4, 729-746(13 Apr 1987). Contract AC03-76SF00515.

The existence of a dilaton field in no scale supergravities implies that the only classical solutions of the dilaton + Einstein equations are those which predict at low temperatures a vast hierarchy between the supersymmetry breaking scale m sub(SUSY) (i.e. the typical squark, slepton and/or gaugino mass) and the Planck scale. At relatively low temperatures the dynamical quantities of the matter + dilaton system relax to some critical time trajectories with the property that the msub(SUSY)(t) and T(t) time trajectories stay proportional. The dimensionless ratio m sub(SUSY)/T is a fixed point of the theory and it is completely independent of the high temperature condition (T ≫ Msub(Planck)) of the matter + dilaton system.

36031 **Geometrical approach to string field theory.** Bardakci, K. (Lawrence Berkeley Lab., CA; California Univ., Berkeley). *Nuclear Physics* [*Section*] *B;* **284**: No. 2, 334-348(6 Apr 1987). Contract AC03-76SF00098.

Starting from an extended version of reparametrization invariance, we construct a lagrangian density for the interacting open bosonic string. We expand the lagrangian density in powers of the fields, and show that, the free part at least, is satisfactory.

36032 **Heterotic string theory on Calabi-Yau manifolds in the Green-Schwarz formalism.** Sen, A. (Stanford Linear Accelerator Center, CA). *Nuclear Physics* [*Section*] *B;* **284**: No. 2, 423-448(6 Apr 1987). Contract AC03-76SF00515.

The σ-model describing the propagation of the heterotic string in a Calabi-Yau background is written down in the Green-Schwarz formulation. This model has manifest N=1 space-time supersymmetry, however only the SO(2) subgroup of the four-dimensional Lorentz group is realized linearly. The criteria for the existence of the full SO(3,1) Lorentz symmetry in this model are studied. These requirements turn out to be identical to those obtained by demanding the existence of space-time supersymmetry in the Neveu-Schwarz-Ramond formulation of the theory, where the SO(3,1) Lorentz symmetry is manifest, but space-time supersymmetry is not. The analysis is easily generalized to more general backgrounds, which give rise to (2,0) superconformal field theories on the world sheet. Finally it is shown that if the requirements which given unbroken N=1 space-time supersymmetry and full SO(3,0) Lorentz invariance are satisfied, then the unbroken gauge group after the compactification of the $E_8 \times E_8$ heterotic string theory on Calabi-Yau spaces is $E_6 \times E_6$.

36033 **Group theory from quarks at the ends of strings.** Marcus, N.; Sagnotti, A. (California Univ., Berkeley; Lawrence Berkeley Lab., CA; Rome-2 Univ., Italy; Istituto Nazionale di Fisica Nucleare, Rome, Italy). *Physics Letters* [*Section*] *B;* **188**: No. 1, 58-64(2 Apr 1987). Grant AC03-76SF00098.

We add D fermionic variables to the ends of open strings, generating the combinatoric and group theory factors of SO(2/sup [D/2]/). Thus 10 variables give SO(32). The results are illustrated by a one-loop calculation, giving the partition function of the theory. We discuss boundary conditions, and the modifications of the Feynman rules needed for obtaining the groups U(2/sup [D/2]/) and USp(2/sup [D/2]/).

36034 **Spin field correlators on an arbitrary genus Riemann surface and non-renormalization theorems in string theories.** Atick, J.J.; Sen, A. (Stanford Univ., CA). *Physics Letters [Section] B;* **186**: No. 3/4, 339-346(12 Mar 1987). Contract AC03-76SF00515.

We calculate the n-point correlation functions of spin fields on an arbitrary genus Riemann surface. We also calculate the corresponding correlators for the spin fields associated with the local supersymmetry ghosts using a specific ansatz for screening the background ghost charge. Using these results we show by explicit calculation that to all orders in the string perturbation theory all n-point amplitudes involving massless fields in the superstring and the heterotic string theory vanish identically for $0 \leqq n \leqq 3$.

36035 **Chiral-invariant regularization of fermions on the lattice.** Rebbi, C. (Brookhaven National Lab., Upton, NY; Boston Univ., MA). *Physics Letters [Section] B;* **186**: No. 2, 200-204(5 Mar 1987). Contract AC02-76CH00016.

We propose a non-local formulation of lattice fermions, which preserves chiral symmetry for vanishing mass and is quite convenient for numerical calculations. We also show that the chiral current exhibits the correct anomalous divergence in the continuum limit.

36036 **Selected topics in gauge theories.** Beg, M.A.G.; Hernandez Galeana, A. (The Rockefeller University, New York, N.Y. 10021). *AIP (American Institute of Physics) Conference Proceedings;* **143**: No. 1, 1-57(20 Jun 1986). (CONF-8412105—).

From Mexican school of particles and fields; Oaxtepec, Morelos, Mexico (3 Dec 1984).

Developments in gauge field theory in the past fourteen years are discussed. The canonical description of electroweak and strong interactions is described including the role played by QCD and QFD. The Salam-Weinberg theory of electroweak interactions is reviewed with emphasis on Higgs mass and renormalization group analysis. Implications of hyper-color theories are discussed. Composite models of quarks and leptons are considered including hyperfermions as part of a subquark multiplet. (AIP)

36037 **Proton decay theory.** Marciano, W.J. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). pp 13-24 of Proceedings of the fourth workshop on grand unification. Weldon, H.A.; Langacker, P.; Steinhardt, P.J. Cambridge, MA; Birkhauser Boston Inc. (1983). (CONF-8304112—). Contract AC02-76CH00016.

From 4. workshop on grand unification; Philadelphia, PA, USA (21 Apr 1983).

The SU(5) Georgi-Glashow model provided much of the motivation for ongoing proton decay experiments as well as a theoretical framework for estimating expected rates and branching ratios. In the so-called "minimal" model, one assumes the existence of a "great desert", i.e. no new particles up to m/sub X/, the unification mass scale. This simplistic assumption has an appealing consequence; it leads to rather definite predictions. If those predictions turn out to be wrong, it doesn't necessarily imply that the concept of grand unification or even that the SU(5) model is invalid. Instead, it would most likely suggest that new physics populates the desert and modifies the predictions.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 34639

36038 **(BNL-NCS—51655-Rev.87) Evaluated nuclear structure data file: A manual for preparation of data sets.** Tuli, J.K. (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010826.

This manual describes the organization and structure of the Evaluated Nuclear Structure Data File (ENSDF). This computer-based file is maintained by the National Nuclear Data Center (NNDC) at Brookhaven National Laboratory for the international Nuclear Structure and Decay Data Network. For every mass number (presently, $A \leqq 263$), the Evaluated Nuclear Structure Data File (ENSDF) contains evaluated structure information. For masses $A \geqq 45$, this information is documented in the Nuclear Data Sheets; for $A < 45$, ENSDF is based on compilations published in the journal Nuclear Physics. The information in ENSDF is updated by mass chains with a present cycle time of approximately six years.

36039 **(NEANDC(J)—123/U) Proceedings of the 1986 seminar on nuclear data.** Nakagawa, Tsuneo; Asami, Tetsuo (eds.). (Japan Atomic Energy Research Inst., Tokai, Ibaraki. Japanese Nuclear Data Committee). Feb 1987. 371p. (INDC(JPN)—109/L; JAERI-M—87-025; CONF-8611159—). JAERI, Tokaimura, Nakagun, 319-11, Japan. File Number TI87900676.

From Seminar on nuclear data; Tokai, Japan (26 Nov 1986).

The seminar focused on problems with nuclear data and reactor constants and their sensitivity analyses. The poster session concerned recent measurements of neutron cross sections and computer codes for theoretical calculations. Separate abstracts were prepared for 34 papers in these proceedings. (DWL)

36040 **(NP—7900812) College of Nuclear Science: Annual report, 1985.** (National Tsing Hua Univ., Hsinchu (Taiwan)). 1986. 345p. NTIS (US Sales Only), PC A15/MF A01. File Number DE87900812.

A review of research facilities and current research projects is presented.

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 35970, 36046

6512 Nuclear Properties And Reactions, A=1-5, Experimental

36041 **Polarized target double and triple spin correlation parameters in elastic proton-deuteron scattering.** Adams, D.L. (Los Alamos National Lab., NM). pp 486-490 of Three-body force in the three-nucleon system. Proceedings. Berman, B.L.; Gibson, B.F. (eds.). Berlin, Germany, F.R.; Springer (1986). (CONF-8604194—).

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

6513 Nuclear Properties And Reactions, A=6-19, Experimental

36042 **Fission and quasifission in U-induced reactions.** Shen, W.Q.; Albinski, J.; Gobbi, A.; Gralla, S.; Hildenbrand, K.D.; Herrmann, N.; Kuzminski, J.; Mueller, W.F.J.; Stelzer, H.; Tke, J. (Gesellschaft fuer Schwerionenforschung, D-6100 Darmstadt, Federal Republic of Germany). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 1, 115-142(Jul 1987).

Triple-differential cross sections have been measured as a function of product mass, total kinetic energy, and center-of-mass scattering angle in reactions induced by /sup 238/U on /sup 16/O, /sup 26/Mg, /sup 27/Al, /sup 32/S, /sup 35/Cl, /sup 40/Ca, /sup 48/Ca, and /sup nat/Zn targets at several bombarding energies between 4.6 and 7.5 MeV/nucleon. The analysis focuses on binary processes in which the product masses are substantially different from the target-projectile masses. These include the complete fusion followed by fission as well as quasifission processes in which large mass transfers occur on a short time scale. The relative contributions of these two components are estimated from the mass-angle correlations and analyzed within the extra and extra-extra push concepts. The time scale for mass transfer in quasifission reactions is derived from turning angles of the intermediate complex, and it is found that the mass drift toward symmetry shows the characteristics of an overdamped motion with a universal time constant independent of scattering system and bombarding energy. This is consistent with the one-body nuclear dissipation mechanism being responsible for the damping in the mass asymmetry degree of freedom. Also the average total kinetic energy of reaction products in quasifission is independent of temperature, supporting the one-body dissipation hypothesis.

36043 **Inelastic pion scattering from /sup 12/C.** Cottingame, W.B.; Boyer, K.G.; Braithwaite, W.J.; Greene, S.J.; Harvey, C.J.; Joseph, R.J.; Holtkamp, D.B.; Moore, C.F.; Kraushaar, J.J.; Peterson, R.J.; and others. (The University of Texas at Austin, Austin, Texas 78712 and New Mexico State University, Las Cruces, New Mexico 88003). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 1, 230-249(Jul 1987).

Differential cross sections for inelastic pion scattering from / sup 12/C at incident energies of 100 to 291 MeV and momentum transfers $\leqq$300 MeV/c have been measured and are compared to results obtained from other probes, particularly electrons and protons. Angular distributions and excitation functions are presented for many of the bound states, including the 4.44-MeV (2^+,0), 7.66-MeV (0^+,0), 9.64-MeV (3^-,0), 12.71-MeV/15.11-Mev (1^+;0,1) doublet, 16.11-MeV (2^+,1), 19-MeV (4^-;0,1) doublet, and 2^- states at 18.25 and 19.4 MeV. Distorted-wave impulse-approximation calculations using both macroscopic and microscopic descriptions of the nuclear wave functions are compared to the data. The observation of an anomalous excitation function for the 15.11-MeV level and the observation of dramatic π^+/π^- asymmetries near 18 and 19 MeV excitation due to isospin mixing between 2^- states and between members of the 4^- doublet are of particular interest.

36044 **Beta and neutrino spectra in the decay of ^{8}B.** Napolitano, J.; Freedman, S.J.; Camp, J. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 1, 298-302(Jul 1987). Contract W-31-109-ENG-38.

We have measured the upper range of the positron momentum spectrum from the decay of ^{8}B. This spectrum is compared to that predicted on the basis of various available measured alpha spectra from the breakup of the daughter ^{8}Be nucleus. Recoil order corrections are included in the comparison. After choosing the most consistent alpha spectrum we infer the ^{8}B neutrino spectrum which we integrate over the /sup 37/Cl(ν/sub e/,e^-) /sup 37/Ar cross section. We obtain (1.07 +- 0.02) x 10/sup -42/ cm^2 for this average cross section where the error is an estimate of the rms (i.e., 1σ) statistical uncertainty from our positron spectrum measurement. This value is appropriate for predicting the solar neutrino capture rate in /sup 37/Cl detectors. Systematic errors in the determination of the integrated cross section are discussed.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

36045 **Confirmation of the 2805-keV level of /sup 38/S.** Warburton, E.K.; Alburger, D.E.; Wang, G. (Brookhaven National Laboratory, Upton, New York 11973). *Physical Review [Section] C: Nuclear Physics;* **36**: No. 1, 429-430(Jul 1987). Contract AC02-76CH00016.

γ-γ coincidence measurements were made following the formation of /sup 38/S via the /sup 36/S(t,pγ)/sup 38/S reaction at E/sub t/ = 3.2 MeV. Gamma-ray spectra gated on the full-energy peak of the 1292-keV γ ray from the decay of the first-excited state clearly showed both 1513- and 1533-keV γ rays, thus confirming the existence of the probable 2805-keV level reported recently in a /sup 36/S(t,pγ)/sup 38/S study.

36046 **Investigation of the continuum decay of /sup 28/Si through particle-gamma and particle-particle coincidence studies.** Schmidt, H.R.; Knopfle, K.T.; Seegert, G.; Grabmayr, P.; Wagner, G.J. (Lawrence Berkeley Lab., 88″ - Cyclotron, Berkeley, CA 94720). pp 328-339 of Proceedings of the workshop on coincident particle emission from continuum states in nuclei. Machner, H.; Jahn, P. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406207—).

From Workshop on coincident particle emission from continuum states (OPECOS '84); Bad Honnef, F.R. Germany (4 Jun 1984).

The authors present an experimental approach to the inelastic continuum making use of both particle-gamma and particle-particle coincidence techniques. The spectroscopy of gamma-rays in coincidence with inelastically scattered particles yields information about all particle decay channels of the continuum. However, it is an inclusive measurement, since the decay products are only indirectly measured. In order to differentiate between reaction mechanisms leading to the same final state, particle-particle coincidences are required, which under certain circumstances recognize different reaction mechanisms through characteristic angular correlations of the decay products.

36047 **Preequilibrium neutron emission in central and peripheral heavy-ion collisions.** Hilscner, D.; Holub, F.; Ingold, G.; Jahnke, U.; Orf, H.; Rossner, H.; Schroder, W.U.; Gemmeke, H.; Keller, K.; Lassen, L. (Hahn-Meitner-Institut fur Kernforschung Berlin, 1000 Berlin 39). pp 268-298 of Proceedings of the workshop on coincident particle emission from continuum states in nuclei. Machner, H.; Jahn, P. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406207—).

From Workshop on coincident particle emission from continuum states (OPECOS '84); Bad Honnef, F.R. Germany (4 Jun 1984).

Preequilibrium neutron emission is observed in central and peripheral collisions of Ho + Ne at 11, 14.6, and 20.1 MeV/μ, and in central collisions of Ho + C at 25 MeV/μ contributing approximately 5 to 15% to the total neutron multiplicity. The present data are compared to inclusive and exclusive experiments on charged-particle emission. Predictions by the Fermi-jet model are seen to be inconsistent with the high-energy neutron component observed for the Ho + Ne and Ho + C reactions, while the exciton model provides a satisfactory reproduction of the data. Asymptotic temperatures of projectile-like fragments produced in the reaction Ho + Ne at 14.6 and 20.1 MeV/μ are found to be larger than those of the corresponding targetlike reaction partners.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

36048 **(IS-T—1288) Shell model studies of the N=50 isotones in the ^{78}Ni 'doubly magic' region.** Winger, J.A. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. File Number DE87010930.

The study of excited states in the N=50 isotones ^{82}Ge and ^{83}As following the β decay of the neutron-rich nuclei ^{82}Ga and ^{83}Ge is reported. This work was performed using the on-line isotope separator facility TRISTAN at Brookhaven National Laboratory. The ^{83}Ge half-life was measured to be 1.85 +- 0.06 s. On the basis of γ singles and γ-γ coincidence measurements a total of 51 γ rays were placed in a level scheme for ^{83}As with 27 levels up to 4.84 MeV. The ^{82}Ga half-life was measured to be 0.62 +- 0.02 s. On the basis of γ singles and γ-γ coincidence measurements, a total of 11 γ rays were placed in a level scheme for ^{82}Ge with 7 levels up to 3.26 MeV. These measurements also established the existence of delayed-neutron emission from ^{82}Ga by the observance of 6 γ rays associated with the depopulation of levels in ^{81}Ge. An angular

correlation measurement was performed for levels in ^{82}Ge to establish J/sup π/ values with only tentative results. The level structure for the N=50 isotones ^{83}Ge, ^{83}As, ^{84}Se, ^{85}Br, and ^{86}Kr are compared with the results of a large-space shell-model calculation assuming an inert ^{78}Ni core. The results of this comparison do not establish the validity of the inert ^{78}Ni core. 45 refs., 21 figs., 18 tabs.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

36049 (GSI—86-22(Prepr.)) Spins, moments and charge radii of indium isotopes in the range of $^{104-127}$In determined by laser spectroscopy. Dinger, U.; Eberz, J.; Huber, G.; Lochmann, H.; Menges, R.; Neugart, R.; Kirchner, R.; Klepper, O.; Kuehl, T.; Marx, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Inst. fuer Physik; European Organization for Nuclear Research, Geneva (Switzerland)). Jul 1986. 45p. NTIS, PC E07; Available from NTIS as TIB/B86-11072.

Hyperfine structures and isotope shifts of indium isotopes in the mass range 104-127 have been measured in the atomic transitions 5p ^{2}Psub(1/2) - 6s ^{2}Ssub(1/2) (410 nm) and 5p ^{2}Psub(3/2) - 6s ^{2}Ssub(1/2) (451 nm) by collinear fast-beam laser spectroscopy. Nuclear magnetic dipole and electric quadrupole moments have been determined for 37 ground and isomeric states. The I=1/2 isomers cross the Schmidt limit to twice its value. Magnetic dipole and electric quadrupole moments of the isotopes are checked by additivity rules. The I=8 isomers exhibit a strong change in the coupling of the hsub(11/2) neutrons. The rms charge radii show a parabolic behaviour with a maximum in the middle of the neutron shell at N=66 resulting from a collective deformation, which is considerably stronger as seen in quadrupole moments or in neighbouring B(E2)-values.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

36050 Low-frequency anomaly in /sup 172/Os moment of inertia. Wells, J.C.; Johnson, N.R.; Baktash, C.; Lee, I.Y.; McGowan, F.K.; Rao, M.N.; Riedinger, L.L.; Janzen, V.; Ma, W.C.; Wen, S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 431-434(Jul 1987). Contract AC05-84OR21400.

An investigation of a low-frequency anomaly in the moments of inertia of the yrast sequence of /sup 172/Os has been carried out via the /sup 144/Nd(/sup 32/S,4n) reaction using a 162-MeV /sup 32/S beam. Gamma-gamma coincidence information was obtained from a large array of Compton-suppressed Ge detectors. The ordering of the yrast sequence was deduced to be the same as had been previously proposed. Self-consistent cranked shell-model calculations and three-band-mixing calculations have been performed, but show only limited success in explaining the anomaly.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

36051 (ANL/NDM—100) Nuclear Data and Measurements Series: The energy dependence of the optical-model potential for fast-neutron scattering from bismuth. Smith, A.B.; Guenther, P.T.; Lawson, R.D. (Argonne National Lab., IL (USA)). May 1987. Contract W-31109-ENG-38. 55p. NTIS, PC A04/MF A01; GPO Dep. File Number DE87011128.

Neutron differential-elastic-scattering cross sections of bismuth were measured at 0.5 MeV intervals from 4.5 to 10.0 MeV. At each incident energy ≧40 differential values were obtained, distributed between 18° and 160°. The measured data were combined with lower-energy results previously reported from this laboratory, and others available in the literature, to provide a detailed data base extending from 1.5 to 10.0 MeV. This data base was interpreted in terms of the conventional optical-statistical model and also a model inclusive of the surface-peaked real potential predicted by the dispersion relation. Particular attention was given to the energy dependence of the volume-integral-per-nucleon of the real potential, J/sub v/, to see if there was evidence of the Fermi Surface Anomaly. In the range 3.0 to 10.0 MeV the present data indicate that dJ/sub v//dE is essentially constant, with a relatively large negative value of -6.0 to -9.0 fm^3, depending on the model used in the analysis. Below 3.0 MeV, there is some evidence for a decrease in the magnitude of dJ/dE. However, the effect is very small and it is only when this trend is combined with considerations of the J/sub v/ values needed to give correct bound-state energies that evidence for the Fermi Surface Anomaly emerges. J/sub v/ and the geometry of the optical potentials found for ^{209}Bi become equal to those needed to explain the high-energy ^{208}Pb data at about 10.0 MeV. Since dJ/sub v//dE for the latter is smaller in magnitude than for ^{209}Bi, a change in dJ/sub v//dE is clearly indicated near 10.0 MeV. This may effect the extrapolation of higher-energy and charged-particle potentials into the lower-energy neutron domain. 47 refs., 9 figs.

36052 (HMI-P—86/2-HF-Prepr.) Extreme sensitivity of quadrupole moments of Rn isomers for small deformations. Berger, A.; Grawe, H.; Mahnke, H.E.; Dafni, E.; Hass, M.; Naim, E.; Rafailovich, M.H. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (Germany, F.R.). Bereich Kern- und Strahlenphysik; Freie Univ. Berlin (Germany, F.R.). Fachbereich Physik; Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1986. 17p. NTIS, PC E07; Available from NTIS as TIB/B87-02017.

The quadrupole moments of proton isomers in /sup 208,210,211/Rn show a drastic increase over the N=126 closed neutron shell isotope /sup 212/Rn. The increase - although consistently understood in the deformed independent-particle model - only indicates a minor deformation of the core when pair scattering into excited high spin orbitals is taken into account properly.

36053 (LBL—23365) Formation of large target residues in intermediate energy nuclear collisions. Loveland, W.; Aleklett, K.; Sihver, L.; Xu, Z.; Seaborg, G.T. (Lawrence Berkeley Lab., CA (USA); Oregon State Univ., Corvallis (USA); Studsvik Neutron Research Lab., Nykoeping). Apr 1987. Contract AM06-70RL02227;AC03-76SF00098. 20p. (CONF-870410—23). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010257.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

We have used radiochemical techniques to measure the yields, angular distributions and velocity spectra of the large (A/sub frag/ ≧ 2/3 A/sub tgt/) target residues from the fragmentation of ^{197}Au by intermediate energy ^{12}C, ^{20}Ne, ^{32}S, ^{40}Ar, ^{84}Kr, and ^{139}La projectiles. The fragment moving frame angular distributions are asymmetric for the lighter projectiles (C-Ar). The fragment velocity spectra are Maxwellian for the Kr induced reactions and non-Maxwellian for the reactions induced by the lighter ions. We interpret these results in terms of a change in the dominant fragment production mechanism(s) from one(s) involving a fast non-equilibrium process for the lighter ions to a slow, equilibrium process for Kr. Comparison of the measured yields and angular distributions with calculations made using a Boltzmann transport equation with appropriate modifications for Pauli blocking, etc., show excellent agreement between data and theory. 12 refs., 12 figs.

36054 Nuclear shape deformations in 485-MeV /sup 56/Fe+/sup 197/Au reactions. Moses, D.J.; Kaplan, M.; La Rana, G.; Parker, W.E.; Lacey, R.; Alexander, J.M. (Department of Chemistry, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 422-424(Jul 1987).

Detailed coincidence studies of light-charged-particle evaporation in 485-MeV /sup 56/Fe+ /sup 197/Au reactions have recently been used to probe the features of fusion-like fission and deeply inelastic reaction mechanisms. We summarize here the average statistical properties which characterize the several identified groups of hot nuclear emitters. These properties are derived from comparisons of observed ^{4}He/^{1}H energy spectra and angular distributions with model calculations. The results demonstrate remarkably low effective evaporation barriers for the very heavy compos-

ite system produced here, consistent with the trends found previously for much lighter systems.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

36055 Anomalously broad spin distributions in sub-barrier fusion reactions. Sahm, C.C.; Murakami, T.; Vandenbosch, R.; Leach, D.D.; Murphy, M.J.; Ray, A. (Washington Univ., Seattle). pp 252-258 of Gross properties of nuclei and nuclear excitations. Proceedings. Feldmeier, H. (ed.). Darmstadt, Germany, F.R.; Technische Hochschule (1986). (CONF-860160—).

From 14. international workshop on the gross properties of nuclei and nuclear excitation; Hirschegg, Austria (13 Jan 1986).

The mean-square spin value of the compound nucleus has been determined from fission fragment angular distributions for the reactions $^{236}U(^{12}C,f)$, $^{232}Th(^{16}O,f)$ and $^{208}Pb(^{16}O,f)$. Currently used fusion models which successfully describe the fusion excitation function fail to reproduce the observed large spin values.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 35999, 36018, 36044, 36051, 36055

36056 (DOE/ER/13447—2) Accurate alpha sticking fractions from improved three-body calculations relevant for muon catalyzed fusion: Progress report, September 1, 1986-August 31, 1987. Szalewicz, K.; Monkhorst, H.J. (Florida Univ., Gainesville (USA). Dept. of Physics). Apr 1987. Contract FG05-85ER13447. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009611.

A summary of major results during the report period is presented in this discussion. Extremely accurate solutions of the Coulomb three-body problem for the tdμ ion. This accuracy was achieved by performing variational 3-body calculations for muonic molecular ions with very large basis sets containing nearly 2000 functions. Very accurate Coulomb sticking fractions were calculated and these calculations demonstrated that the discrepancy between calculated and measured values of sticking fractions cannot be explained without considering effects beyond 3-body Coulomb interactions. The influence of strong nuclear forces on the dtμ wave function has also been investigated.

36057 (GSI—86-45-Prepr.) Zero-point oscillations and the nuclear charge density. Friman, B.L. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1986. 9p. (CONF-8609163—12-Prepr.). NTIS, PC E07; Available from NTIS as TIB/B87-00438.

From International conference and symposia on unified concepts of many-body problems; Stony Brook, NY, USA (4 Sep 1986).

The effect of ground state correlations on the density distributions of nuclei is discussed. The connection with correlation effects on other one-body properties is stressed. The occupation probability for a single-particle state in the correlated ground state is estimated in a semiclassical approximation. The theoretical predictions are compared with empirical charge densities obtained by electron scattering.

36058 (LA-UR—87-1705) Mechanism of dissipation in heavy-ion reactions. Nix, J.R.; Sierk, A.J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 9p. (CONF-8706113—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010124.

From 6. Adriatic international conference on nuclear physics; Dubrovnik, Yugoslavia (15 Jun 1987).

We discuss a new surface-plus-window mechanism for the conversion of nuclear collective energy into internal degrees of freedom at intermediate excitation energies. This novel dissipation mechanism, which results from the long mean free path of nucleons inside a nucleus, involves interactions of either one or two nucleons with the moving nuclear surface and also, for dumbbell-like shapes encountered in heavy-ion reactions and fission, the transfer of nucleons through the window separating the two portions of the system. To illustrate the effect of surface-plus-window dissipation on heavy-ion-fusion reactions we present dynamical calculations for values of the dissipation strength corresponding to 27% and 100% of the Swiatecki wall-formula value, as well as for no dissipation. In addition to dynamical thresholds for compound-nucleus formation in heavy-ion reactions, our new picture describes such other phenomena as experimental mean fission-fragment kinetic energies for the fission of nuclei throughout the periodic system, enhancement in neutron emission prior to fission, short scission-to-scission times in sequential ternary fission, widths of mass and charge distributions in deep-inelastic heavy-ion reactions, and widths of isoscalar giant quadrupole and giant octupole resonances. 32 refs., 2 figs.

36059 (NORDITA—84/10-Prepr.) Nuclear field theory treatment of K not = 0 rotational bands. Arve, P. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Apr 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE86701660.

The properties of te lowest members of k not = 0 rotational bands are described as anharmonic vibrational bands. The anharmonicity is calculated by the method called Nuclear Field Theory (particle-vibration coupling). It is shown to be important not to truncate the diagrammatic expansion at a fixed number of vertices. Instead, the way in which the diagrams depend on the number of degrees of freedom participating is used to guide the truncation.

36060 (NORDITA—84/14-Prepr.) Barrier penetration in the presence of coupling to intrinsic degrees of freedom. Dasso, C.H.; Landowne, S.; Winther, A. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Technische Univ. Muenchen (Germany, F.R.); Niels Bohr Inst., Copenhagen (Denmark)). May 1984. 31p. NTIS (US Sales Only), PC A03/MF A01. File Number DE86701663.

The barrier penetration problem in the presence of couplings to intrinsic degrees of freedom is discussed in a framework suitable for describing heavy-ion fusion reactions. The inward-outward integration formulation with an ingoing-wave boundary condition leads to an efficient algorithm for numerical calculations. Short-wavelength approximations are introduced to obtain semi-quantal equations. These are used to derive the leading order effects of the coupling on the barrier penetration probability for the general case and to solve a coupled harmonic oscillator problem to all orders. The characteristic enhancement of the penetration due to the coupling in the barrier region and the interference between the inside and outside regions are discussed.

36061 (OUP—87-04) What happened to the Kuo-Brown interaction?. Osnes, E. (Oslo Univ. (Norway). Fysisk Inst.). Jan 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752186.

Twenty years of efforts to calculate the shell-model effective interaction, starting from the free nucleon-nucleon (NN) interaction and using many-body perturbation theory, are briefly reviewed. A description is given of the pioneering work of Kuo and Brown, in which the effective interaction was approximated by the Bethe-Brueckner-Goldstone G-matrix and the lowest order core-polarization correction. Subsequent developments which cast doubt upon the simple Kuo-Brown approximation are reviewed. Some of these problems have been shown to arise from inadequate treatment of various higher order contributions, whereas other problems are related to the strong tensor component of the NN interaction used. In fact, modern meson-exchange potentials have much weaker tensor forces and give rise to effective interactions which are similar to the original Kuo-Brown interaction. Applications of these new effective forces to shell-model calculations in the sd-shell are discussed. 40 refs.

36062 (PPA-T—57) Malaysia's entry into a neutron-scattering programme. Abdul Ghaffar Ramli; Mohamad Deraman. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)). Oct 1986. 10p. (CONF-8611155—1). NTIS (US Sales Only), PC A02/MF A01. File Number DE87702405.

From 3. Australian Institute of Nuclear Science and Engineering conference on neutron scattering; Lucas Heights, Australia (6 Nov 1986).

The neutron-scattering programme in Malaysia had been planned and re-planned since 1982, soon after Malaysia's first research reactor was commissioned. Currently, and most definitely, the neutron-scattering programme will start off with small-angle neutron-scattering (SANS). This seems to be in contrast with other nations' neutron-scattering programmes where the usual activity would first be neutron diffraction. This paper gives the reasons behind the selection of small-angle neutron-scattering (SANS) as a starting point. The design of Malaysia's SANS instrument and its expected applications will be explained. Other matters, especially those related to expected future developments or arrangements will also be discussed.

36063 **Pair transfer at high angular momenta.** Egido, J.L.; Rasmussen, J.O. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 316-326(Jul 1987). Contract AC03-76SF00098.

Realistic calculations of the pair transfer strength functions were performed for the nuclei /sup 162/Dy and /sup 164/Dy as a function of the angular momentum and excitation energy in the frame of the self-consistent, cranked Hartree-Fock-Bogoliubov and random-phase-approximation theories. At low angular momenta most of the strength is concentrated in the ground-to-ground transition, whereas at high angular momenta, after the pairing correlation has dropped, the strength is spread among several states located a few (≦4) MeV above the yrast line.

36064 **Sigma model calculations of neutron-rich nuclear matter.** Prakash, M.; Ainsworth, T.L. (Physics Department, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 346-353(Jul 1987).

We examine the role of many-body effects provided by the chiral sigma model in the equation of state of symmetric nuclear matter and neutron-rich matter. Using the parameters determined by fitting the known equilibrium properties of symmetric and slightly neutron-rich matter, the equation of state with arbitrary neutron excess is calculated. The role of the nuclear symmetry energy on the structure of beta stable neutron stars is discussed.

36065 **Pseudovector versus pseudoscalar theory in kaon photoproduction from nucleons and nuclei.** Bennhold, C.; Wright, L.E. (Department of Physics and Astronomy, Ohio University, Athens, Ohio 45701). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 438-440(Jul 1987).

The reaction $^{1}H(\gamma,K^{+})\Lambda^{0}$ is used to compare pseudovector with pseudoscalar coupling for the KAN vertex. The operator is based on diagrammatic techniques and includes the Born terms along with the K/sup */ and Σ exchange terms. Obtaining the coupling constants from a least squares fit shows that the data do not prefer one coupling over the other. Implanting the process into the nucleus yields only small differences between the two interactions.

36066 **Sum rule for two-particle excitation processes in heavy-ion reactions.** Dasso, C.H.; Liotta, R.J. (The Niels Bohr Institute, DK-2100 Copenhagen , Denmark and Sektion Physik der Universitaet Muenchen, Am Coulombwall 1, D-8046 Garching, Federal Republic of Germany). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 448-451(Jul 1987).

A measure of the strength available for the excitation of collective pair transfer channels in heavy-ion reactions is introduced. This combines direct pair pickup and stripping processes, and is expressed in the form of an energy-weighted sum rule. Distributions of strength and of coupling matrix elements in the case of /sup 208/Pb are presented.

36067 **Modification of nuclear β decay by intense low-frequency electromagnetic waves.** Friar, J.L.; Reiss, H.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **36**: No. 1, 283-297(Jul 1987).

A unified treatment is presented of allowed and forbidden nuclear β decay in the presence of an intense, low-frequency, coherent classical electromagnetic wave. After discussing the various scales in the problem, a straightforward evaluation of the transition probabilities is presented which avoids techniques that have been previously criticized. A brute force integration of the electron spectrum for the nonrelativistic (electron) case demonstrates that there is no field-dependent enhancement of the total rate in the long-wavelength limit, which agrees with some previous conclusions. A classical argument is presented which demonstrates in all of our cases that there is no enhancement of the total rate in that limit. Finally, a discussion in perturbation theory of many of the appropriate quantum mechanical excitation mechanisms is presented, together with a discussion of gauge invariance.

36068 **Improved Nilsson parameter set in the Au-Pt region.** Jing-ye Zhang; Larabee, A.J.; Riedinger, L.L. (Oak Ridge National Lab., TN, USA; Tennessee Univ., Knoxville, USA. Dept. of Physics and Astronomy). *Journal of Physics F (London). Metal Physics (London);* **13**: No. 5, L75-L83(May 1987).

Recent data on ^{185}Au indicate that previously published Nilsson (kappa μ) parameter sets for the Au-Pt-Hg region are not able to reproduce either the bandhead energies for the odd-proton configurations or the single-particle structure of the higher-spin states in ^{185}Au. A new set of (kappa, μ) parameters are deduced for the N = 5 and N 6 proton shells in order to give better agreement between the calculated and experimental results. The Nilsson single-particle orbits obtained using the new (kappa, μ) parameters are compared with the Woods-Saxon results for this region.

36069 **Liquid-gas phase separation in nuclear collisions and nucleosynthesis in central Nb+Nb and Ca+Ca collisions.** Csernai, L.P.; Kapusta, J.I.; Glendenning, N.K.; Fai, G. (Minnesota Univ., Minneapolis; Lawrence Berkeley Lab., CA; Kent State Univ., OH). pp 146-150 of Gross properties of nuclei and nuclear excitations. Proceedings. Feldmeier, H. (ed.). Darmstadt, Germany, F.R.; Technische Hochschule (1986). (CONF-860160—).

From 14. international workshop on the gross properties of nuclei and nuclear excitation; Hirschegg, Austria (13 Jan 1986).

There is a persistent effort to determine the nuclear equation of state using heavy ion reactions. The first step on this way is to measure the thermodynamical parameters of the final breakup state like T, S, n, e. Since these are not directly measurable quantities both theoretical and experimental efforts are needed. The problems of the theoretical side were pointed out in a recent experimental paper. This inspired us to recalculate the breakup entropy, density, temperature, etc. in a model including nuclear excited states, their decays, finite particle volumina and microcanonical statistics. We compared the d-like to charge ratio, x, and the sum of squared deviations of all fragment to proton ratios weighted by the fragment mass, to the experimental quantities.

36070 **Chiral nonperturbative hadronic structures.** Kunz, J.; Boguta, J. (Giessen Univ., Germany, F.R.; Lawrence Berkeley Lab., CA). pp 167-170 of Gross properties of nuclei and nuclear excitations. Proceedings. Feldmeier, H. (ed.). Darmstadt, Germany, F.R.; Technische Hochschule (1986). (CONF-860160—).

From 14. international workshop on the gross properties of nuclei and nuclear excitation; Hirschegg, Austria (13 Jan 1986).

Low energy phenomenology does not decide in which way chiral symmetry is realized. But QCD indicates, that the low energy effective theory realizes chiral symmetry non-linearly. One main result that is reported here is the demonstration that the linear realization of chiral symmetry is incompatible with observed nuclear structure. Also, a non-linear chiral models is discussed, that is compatible with nuclear structure. In such a field theory the vector fields, such as the p-field, can be introduced as gauge fields.

36071 **Bound-state properties. Summary and recommendations of Working Group 1.** Friar, J.L.; Frois, B. (Los Alamos National Lab., NM; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France). pp 81-91 of Three-body force in the three-nucleon system. Proceedings. Berman, B.L.; Gibson, B.F. (eds.). Berlin, Germany, F.R.; Springer (1986). (CONF-8604194—).

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

The trinucleon bound state is the natural testing ground for most of our efforts to determine the effects of three-nucleon forces. The existence of these forces, which depend on the simultaneous coordinates of three nucleons, arises from neglecting non-nucleonic degrees of freedom, such as the excitation of a nucleon in an intermediate state between two exchanges of mesons. Three-body forces are additional forces which may have to be taken into account to explain the binding energies of nuclei for A≧3. In the trinucleon system typical three-nucleon forces change the binding energy by 5-15%, although they generate a much smaller fraction (1-2%) of the total potential energy. This relative smallness has proven to be a serious problem because, until recently, the reliability of calculations was insufficient and there was considerable uncertainty over the accuracy of the wave functions (needed to calculate observables) and eigenvalues. This symposium has shown that considerable progress has recently been achieved. In particular the calculation of the trinucleon bound-state properties due to two-body interactions is now well under control. The different numerical techniques used by various groups show remarkable covergence in the binding energies at a level of accuracy of about 10 keV.

36072 **Quark induced three-body forces.** Maltman, K. (Los Alamos National Lab., NM). pp 412-421 of Three-body force in the three-nucleon system. Proceedings. Berman, B.L.; Gibson, B.F. (eds.). Berlin, Germany, F.R.; Springer (1986). (CONF-8604194—).

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

The effects of three-body forces induced in the ^{3}He, ^{4}He systems by the requirements of quark antisymmetry are estimated in the context of a QCD-inspired non-relativistic potential model. The results are found to be sensitive to both the short distance structure of the spin independent quark potential and poorly known short distance features of the nuclear wavefunction, but suggest that quark induced effects are likely to play a non-trivial role in understanding binding discrepancies in the three nucleon system unless nucleon quark cores are anomalously small relative to the physical nucleon size.

36073 **Relativistic particle quantum dynamics and three-body forces in the three-nucleon system.** Coester, F. (Argonne National Lab., IL). pp 472-481 of Three-body force in the three-nucleon system. Proceedings. Berman, B.L.; Gibson, B.F. (eds.). Berlin, Germany, F.R.; Springer (1986). (CONF-8604194—).

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

The most important data on short-range effects are produced by electromagnetic probes, and the central questions relating the three-nucleon system to fundamental theory concern the role which explicit quark degrees of freedom should play in the three-nucleon dynamics. Three-body forces do not necessarily play a pivotal role in these probleme. Requirements of relativistic invariance, however, can be expected to have an important quantitative impact on all short-range properties of the three-nucleon system.

36074 **Minimal relativistic model for the three-nucleon system.** Noyes, H.P. (Stanford Linear Accelerator Center, CA). pp 495-499 of Three-body force in the three-nucleon system. Proceedings. Berman, B.L.; Gibson, B.F. (eds.). Berlin, Germany, F.R.; Springer (1986). (CONF-8604194—).

From International symposium on three-body force in the three-nucleon system; Washington, DC, USA (24 Apr 1986).

36075 **Pairing and shell effects in (p,xn) preequilibrium emission.** Blann, M.; Hansen, L.F.; Komoto, T.; Pohl, B.A.; Wong, C.; Grimes, S.M.; Holler, Y.; Scobel, W.; Trabandt, M. (Lawrence Livermore National Lab., Livermore). pp 46-70 of Proceedings of the workshop on coincident particle emission from continuum states in nuclei. Machner, H.; Jahn, P. Teaneck, NJ; World Scientific Pub. Co. (1984). (CONF-8406207—). Contract W-7405-ENG-48.

From Workshop on coincident particle emission from continuum states (OPECOS '84); Bad Honnef, F.R. Germany (4 Jun 1984).

Semiclassical preequilibrium (PE) models that describe a nuclear reaction to proceed through a sequence of nucleon-nucleon interactions in the nuclear environment have been very successful in reproducing smooth continuous energy spectra for a broad range of nucleon induced reactions. Simplifications in these calculations - like the assumption of equidistant single particle (s.p.) states, neglect of pairing or deformation effects - make them less capable of reproducing structural differences between adjacent target isotopes or isotones. This paper deals with such deviations observable in angle integrated and angle differential cross sections of (p,xn) reactions with E/sub p/ = 18-26 MeV projectiles and several targets and suggests to use partial state densities based on realistic s.p. energies for their explanations.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 34715, 35460, 35822, 36039

36076 **(AD-A—178858/7/XAB) Frequency spectrum of soft x-ray emission from transition radiation. Master's thesis.** Yoon, S.K. (Naval Postgraduate School, Monterey, CA (USA)). Dec 1986. 61p. NTIS, PC A04/MF A01.

The absolute differential production efficiencies from foil stack materials for an electron beam energy of 65 MeV were measured. The spectra shapes and the absolute differential production efficiencies for each of the four foil stacks are well matched by the calculated values. The transition radiation cone was measured using a motor-driven detector. The measured apex angle is in agreement with the optimum radiation cone angle. Aluminum bandwidth narrowing associated with K-edge absorption was observed. The production intensity was compared with the theoretical prediction and interpreted in terms of absorption and coherence.

36077 **(AD-A—178859/5/XAB) Angular distribution of transition radiation in the soft x-ray spectrum. Master's thesis.** Yim, C.H. (Naval Postgraduate School, Monterey, CA (USA)). 18 Dec 1986. 61p. NTIS, PC A04/MF A01.

The angular distribution of transition radiation has been investigated theoretically and experimentally. The theoretical prediction and the computer-graphic analysis are presented in families of plots which illustrate the dependence of the intensity on the emission angle. Although the experimental method used had limited resolution, the optimum cone angles of the x ray radiation were in agreement with the theoretical values. Problems encountered during the experiment are discussed for continuing work. This work may have several important applications in electron-beam diagnostics. These include monitoring of the beam emittance and energy.

36078 **(CONF-870405—2) Group structure and weighting function effects on neutron penetration through thick sodium-iron shields.** Fu, C.Y.; Ingersoll, D.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE86015178.

From Radiation protection and shielding conference; Knoxville, TN, USA (22 Apr 1987).

The effects of group structures and weighting functions on neutron penetration through a thick Na-Fe geometry are studied. The recommended broad-group (61-neutron/23-gamma-ray) and few-group (22-neutron/10-gamma-ray) structures are tailored to the sodium and iron resonances, windows, and capture gamma-ray spectra. The best weighting functions are shown to be fine-group fluxes selected from a few key locations in the geometry. These group structures and weighting functions, relative to existing group structures and conventional weighting functions, improve the accuracy of the computed 61-neutron-group Bonner ball responses by up to one hundred percent and of the computed 22-neutron-group results by up to six hundred percent.

36079 (CONF-8509398—1) Secondary charged particle spectra and kerma calculations. Coyne, J.J.; Gerstenberg, H.M.; Hennen, L.A. (National Bureau of Standards, Washington, DC (USA); Gezondheidsorganisatie TNO, Rijswijk (Netherlands). Radiobiologisch Inst. TNO; Cohen (J.A.) Inst. voor Radiopathologie en Stralenbescherming, Leiden (Netherlands)). 16 Sep 1985. Contract AI05-86ER60389. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011187.

From IAEA advisory group meeting on nuclear and atomic data for radiotherapy and radiobiology; Rijswijk, Netherlands (16 Sep 1985).

The calculation of kerma factors from known cross sections is not as simple as is often implied. The kerma factors are strongly influenced by the reaction mechanism assumed. An important example of this dependence on the reaction mechanism is the contribution of the $^{12}C(n,n')3\alpha$ reaction to the total kerma in carbon. First, a short review will be given of the ENDF/B-V carbon cross sections which were used in the calculation of carbon kerma factors. Using the reaction channels implied in the ENDF/B-V evaluation, the contribution of various reactions to the total kerma factors in carbon will be given. A detailed analysis of the reaction mechanisms which could contribute to the $(n,n')3\alpha$ reaction in carbon has been carried out. First their contribution to kerma, independent of cross section, will be calculated and then the initial spectra of alpha particles produced by the various reaction mechanisms will be given. A discussion of possible ways of experimentally distinguishing the reaction mechanisms will be made by comparing their different initial spectra and their variation in kerma with neutron energy. Finally, the event-size spectra for tissue-equivalent proportional counters will be presented, giving only the contributions from the $(n,n')3\alpha$ reaction and its various possible reaction channels. 3 refs., 11 figs., 4 tabs.

36080 (FNAL-TM—1354) Radiation shielding for 250 MeV protons. Awschalom, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 1 Apr 1987. Contract AC02-76CH03000. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009033.

This paper is targetted at personnel who have the responsibility of designing the radiation shielding against neutron fluences created when protons interact with matter. Shielding of walls and roofs are discussed, as well as neutron dose leakage through labyrinths. Experimental data on neutron flux attenuation are considered, as well as some calculations using the intranuclear cascade calculations and parameterizations.

36081 Channeling radiation from GaAs. Park, H.; Kephart, J.O.; Klein, R.K.; Pantell, R.H.; Berman, B.L.; Datz, S. (Department of Electrical Engineering, Stanford University, Stanford, California 94305). *Physical Review [Section] B: Condensed Matter;* **36**: No. 2, 1259-1261(15 Jul 1987).

Channeling-radiation spectra have been obtained from a GaAs crystal with 16.9-MeV electrons and with 54.4-MeV electrons and positrons. Theoretical calculations are in reasonably good agreement with the experimental results.

6550 Medical Physics

REFER ALSO TO CITATION(S) 35513, 35516, 35820

36082 (DOE/ER/60390—1) Electron transport calculations with biomedical and environmental applications. (National Bureau of Standards, Washington, DC (USA)). 1987. Contract AI05-86ER60390. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010699.

This document reports on studies of radiation interactions with matter and of radiation transport in bulk media in order to generate basic radiological physics information needed as input for biomedical radiation dosimetry, the assessment of radiation hazards in nuclear technology, and modeling of biological radiation action. This work includes the development of transport-theoretic methods, the compilation and critical evaluation of the underlying single-scattering cross sections, and the application of the transport methods to radiological physics problems. 13 refs.

36083 (PNL—6163) DOE radiological calibrations intercomparison program: Results of fiscal year 1986. Cummings, F.M.; Roberson, P.L.; McDonald, J.C. (Pacific Northwest Lab., Richland, WA (USA)). May 1987. Contract AC06-76RL01830. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010328.

The Department of Energy Radiological Calibration Intercomparison Program was initiated in January 1986, under the research portion of the DOE Laboratory Accreditation Program. The program operates via the exchange of transfer standards, consisting of instrument sets and standard secondary beta sources. There are two instrument sets and the scheduled use has been staggered such that one set is available for use during each month. One set of secondary standard beta sources is available for use bimonthly. During the 1986 fiscal year, five laboratories used the instrument sets and three laboratories used the beta source set. Results were reported for all the measurements. The average and one standard deviation of the ratios of participant results to Pacific Northwest Laboratory calibration values were 1.12 +- 0.17 for gamma measurements. Those ratios for the gamma measurements varied from 0.98 to 3.06. The larger differences of results from measurements performed at two facilities were directly attributable to unfamiliarity with the intercomparison instruments. The average and one standard deviation of the ratios of participant results to PNL calibration values obtained using the secondary ^{90}Sr beta source was 1.02 +- 0.05, which is well within measurement uncertainties. The one participant who performed measurements using ^{147}Pm and ^{204}Tl sources obtained ratios of 0.68 and 1.11, respectively. No measurements were performed using neutron or x-ray sources.

36084 (SSI—86-06) Cesium 137 of the control group of the Institute of Radiation Protection in 1985. Eklund, G.; Falk, R. (National Inst. of Radiation Protection, Stockholm (Sweden)). 22 Apr 1986. 6p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752191.

The variation of the contents of Cesium 137 of the groups in course of time is reflecting the changes of radioactive fallout caused by nuclear weapon test explosions in the atmosphere. The average value has been calculated to be 44 Bq for 1985 and there have been no major changes during the past 10 years. (G.B.).

36085 (SSI—86-08) Scandinavian comparative measurements of radioactivity in building materials. Moere, M. (National Inst. of Radiation Protection, Stockholm (Sweden)). 12 Jun 1986. 9p. (In Swedish). NTIS (US Sales Only), PC A02/MF A01. File Number DE87752192.

The activities of radium 226, potassium 40, actinium 228 and thorium 228 have been determined by gamma measurement of three specimens with different densities. The standard deviation was about 10 percent, independent of density. (G.B.).

36086 (SSI—86-09) Emission of activity and professional exposure by the nuclear power industry. (National Inst. of Radiation Protection, Stockholm (Sweden)). 18 Jun 1986. 38p. (In Swedish). NTIS (US Sales Only), PC A03/MF A01. File Number DE87752193.

The compilation is made for the period October-December 1985 and for the whole year. It is presented in standard emissivity and as an index of collective dose equivalent. A survey of doses of the personnel at nuclear power plants is included. (G.B.).

36087 Stochastic basis for dose-response curves, RBE, and temporal dependence. Bond, V.P. (Brookhaven National Lab., Upton, NY 11973). pp 387-402 of Radiation carcinogenesis: Epidemiology and biological significance. Boice, J.D.; Fraumeni, J.F. New York, NY; Raven Press (1984). Contract AC02-76CH00016.

The aim of this paper is to use biophysical-microdosimetric quantities, measured in a physical surrogate or phantom cell, to explain the shape of absorbed dose-quantal cell response curves, the role of radiation quality, and the influence of dose rate. Responses expected are explored first in "simple" autonomous cell systems, followed by increasingly complex systems. The approaches used appear to account well for most experimental findings in autonomous cell systems. Complications seen with increasingly complex

systems appear to be confined largely to the higher dose and dose-rate ranges.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 35158, 35180, 35243, 35256, 35939, 35953, 36076, 36168, 36192

36088 (IS-T—1272) Nonradiative excitation decay of dyes on insulators and semiconductors. Crackel, R.L. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. File Number DE87010920.

One of the practical problems associated with dye-sensitized semiconductors in liquid-junction solar cells has been the very low conversion efficiencies that have been reported. To better understand the causes of this problem, picosecond time-correlated photon counting fluorescence profiles were collected from dye molecules on different substrates. In one experiment cresyl violet (CV) molecules were adsorbed on fused quartz substrates at submonolayer coverages. It was found that the best description of the energy transfer between the monomeric and dimeric forms of CV was given by a model having an exponential term and a two-dimensional Foerster term. Another set of experiments examined the distance dependence of the lifetime of emitting CV molecules spaced at various distances from a TiO_2 surface by means of Cd-arachidate monolayers. Nonradiative excitation transfer is found to be an important mechanism for this situation. The measured lifetimes are compared to the theoretical lifetime vs. distance curves for TiO_2 that are calculated from the Chance, Prock, and Silbey theory. In the final set of experiments that are discussed, the fluorescence decay profiles for rhodamine 3B (Rh3B) molecules adsorbed directly on fused quartz, TiO_2, and ZnO substrates are collected and analyzed. It was found that the two-dimensional Foerster model fits the data from all three substrates and gives reasonable values of the natural lifetime, tau, and reduced trap concentration, C/sub T/. This suggests that the energy acceptors are located in the surfaces of the substrates. 150 refs.

36089 (IS-T—1308) NMR line shape studies of static and dynamic systems. Chu, Po-Jen. (Ames Lab., IA (USA)). Jun 1987. Contract W-7405-ENG-82. 279p. NTIS, PC A13/MF A01; 1; GPO Dep. File Number DE87010919.

This report is divided into four parts: field dependence of NMR static powder line shape (studies of mutual orientation of interaction tensors from the field dependence of the critical frequencies); study by solid-state NMR of Cs-133 and H-1 of a hydrated and dehydrated cesium mordenite; exchange dynamics of Na-23 and structural incommensuration in $NaMo_4O_6$ (NMR dynamic line shape for second order quadrupolar central transition); characterization of hydrogen in $Zr_6Cl_{12}H$ and ZrClO/sub x/H/sub y/ (studies of interstitial hydrogen within metal clusters).

36090 (LA-UR—87-1707) Effective interactions and elementary excitations in quantum liquids. Pines, D. (Los Alamos National Lab., NM (USA); Illinois Univ., Urbana (USA). Dept. of Physics). 1986. Contract W-7405-ENG-36. 43p. (CONF-8609163—11). NTIS, PC A03/MF A01; GPO Dep. File Number DE87010125.

From International conference and symposia on unified concepts of many-body problems; Stony Brook, NY, USA (4 Sep 1986).

The effective interactions which provide a wavevector and frequency dependent restoring force for collective modes in quantum liquids are derived for the helium liquids by means of physical arguments and sum rule and continuity considerations. A simple model is used to take into account mode-mode coupling between collective and multiparticle excitations, and the results for the zero-temperature liquid ^{4}He phonon-maxon-roton spectrum are shown to compare favorably with experiment and with microscopic calculation. The role played by spin-dependent backflow in liquid ^{3}He is analyzed, and a physical interpretation of its variation with density and spin-polarization is presented. A progress report is given on recent work on effective interactions and elementary excitations in nuclear matter, with particular attention to features encountered in the latter system which have no counterparts in the helium liquids.

36091 (LA-UR—87-1737) Analytical and numerical solution of one- and two-dimensional steady heat transfer in a coldplate. Jones, G.F.; Bennett, G.A.; Bultman, D.H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 12p. (CONF-870623—8). NTIS, PC A02. File Number DE87010128.

From 22. AIAA thermophysics conference; Honolulu, HI, USA (8 Jun 1987).

We develop analytical models for steady-state, one- and two-dimensional heat transfer in a single-material, flat-plate coldplate. Discrete heat sources are mounted on one side of the plate and heat transfer to a flowing fluid occurs on the other. The models are validated numerically using finite differences. We propose a simple procedure for estimating maximum coldplate temperature at the location of each heat source which includes thermal interaction among the sources. Results from one model are compared with data obtained for a composite coldplate operated in the laboratory. We demonstrate the utility of the models as diagnostic tools to be used for predicting the existence and extent of void volumes and delaminations in the composite material that can occur with coldplates of this type. Based on our findings, recommendations for effective coldplate design are given.

36092 (LBL—23257) Theory of quasiparticle energies: Band gaps and excitation spectra in solids. Louie, S.G.; Hybertsen, M.S. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract AC03-76SF00098. 27p. (CONF-870340—2). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87009644.

From International symposium on atomic, molecular and solid state theory, scattering problems, many-body phenomena, and computational methods; St. Augustine, FL, USA (16 Mar 1987).

A first-principles theory for the band gaps and electronic excitation energies in crystals is described. Optical and photoemission spectra are properly interpreted as transitions between quasiparticle states of the many-electron system. The theory requires adequate treatment of the Coulomb interaction between the electrons including exchange and dynamical correlation effects. The nonlocal energy-dependent electron self-energy operator is evaluated from first principles using the full dielectric matrix and the dressed Green's function. Quasiparticle energies for materials covering a wide range of metallicity and ionicity are presented. With no empirical input, the calculated band gaps, optical transition energies, and band dispersions are all within a few percent of experimental values. For semiconductors and insulators, we find that local field effects in the screening of the Coulomb interaction and dynamical renormalization are both crucial for accurate results. The present method also extends beyond the case of bulk crystals, e.g., to surfaces. Results on the surface state energies of the Ge(111):As and Si(111):As surface are discussed and compared with experiment. 34 refs., 7 figs., 5 tabs.

36093 (LBL-PUB—433-5-87/255) μSR newsletter: No. 33, May 12, 1987. Crowe, K.M.; Portis, A.M.; Yamazaki, T. (eds.). (Lawrence Berkeley Lab., CA (USA); Tokyo Univ. (Japan). Meson Science Lab.). 12 May 1987. Contract AC03-76SF00098. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010938.

Four individual papers have been cataloged separately. (WRF)

36094 (SAND—86-0404) Stress wave generation by radiation absorption. Gover, J.; Browning, J. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010842.

Models of stress wave generation by radiation absorption as well as materials data that the authors have accumulated in their work on radiation effects are presented. The emphasis is on a tutorial presentation of these models with a focus on techniques that can be used for hand analysis. The intent is to give the reader a "physical feel" for stress wave generation and propagation. All analyses are done in 1 spatial dimension. These models are useful to those working in radiation effects who need to perform an occasional thermomechanical stress calculation but have neither the

time nor inclination to learn how to use the rather sophisticated hydrocodes.

36095 **(SAND—86-2585C) Development of gaseous tracer techniques for pore structure characterization of granular materials.** Erickson, K.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 17p. (CONF-8703134—1). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008521.

From JANNAF propulsion systems hazards subcommittee; Redstone Arsenal, AL, USA (30 Mar 1987).

A systematic theoretical and experimental approach involving multiple tracer techniques is being developed to evaluate five characteristic parameters that describe the major features of a macroscopically uniform pore structure: (1) the portion of the total pore space that forms flow paths (flow porosity), (2) the fraction that forms relatively stagnant paths (stagnant porosity), (3) the tortuosity of the flow porosity, (4) the specific surface area of the pore space, and (5) the fraction of the specific surface area that is associated with the flow porosity. Initial experiments with samples having simple, known pore structures were conducted to evaluate the theory and experimental equipment. Agreement between known and experimentally determined parameter values was good. Although additional technique development using samples having more complicated pore structures is required, it appears that the tracer techniques can have broad application as a nondestructive diagnostic tool for examining granular materials.

36096 **(UCRL—94327) Microwave and x-ray generation from CO_2 laser irradiated targets.** Bach, D.R.; Evans, S.; Forslund, D.W.; Yates, M.A.; Koehler, H.A.; Zacharias, R.A. (Los Alamos National Lab., NM (USA); Lawrence Livermore National Lab., CA (USA)). Oct 1985. Contract W-7405-ENG-48. 16p. (CONF-851053—19). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009606.

From 7. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (28 Oct 1985).

Copious microwaves are emitted when sufficiently intense, pulsed radiation from the Antares CO_2 laser was impinged on a cylindrical polyethylene. The microwaves omitted were investigated as to pulse width and power spectrum in the frequency range of 26 to 40 GHz. As the CO_2 laser excels in the production of hard x-rays, Helios and Antares data on high-Z targets are also presented. This paper describes the experimental setup, results obtained, and general conclusions regarding laser produced microwaves. (WRF)

36097 **(UCRL—96688) Local density calculated parameters for the Anderson Hamiltonian.** McMahan, A.K.; Martin, R.M. (Lawrence Livermore National Lab., CA (USA); Xerox Palo Alto Research Center, CA (USA)). May 1987. Contract W-7405-ENG-48. 13p. (CONF-8705120—1). NTIS, PC A02/MF A01; GPO Dep. File Number DE87010339.

From NATO advanced workshop on narrow band phenomena; Staverden, Netherlands (31 May 1987).

Local density functional theory has recently been used to provide first principles calculation of parameters entering the impurity Anderson Hamiltonian, with promising results. Examples are presented here for the case of the rare earth dioxides CeO_2 and PrO_2.

36098 **Optimization of the energy resolution of deep level transient spectroscopy.** Nolte, D.D.; Haller, E.E. (Lawrence Berkeley Laboratory and Department of Physics, University of California, Berkeley, California 94720). *Journal of Applied Physics;* **62**: No. 3, 900-906(1 Aug 1987). Contract AC03-76SF00098.

We address the problem of optimizing the energy resolution of deep level transient spectroscopy, emphasizing techniques which are applicable for signals from defect levels which are either alloy broadened or stress broadened and which therefore produce nonexponential or multiexponential transients. We discuss the possibility of using a numerical inverse Laplace transform for which there is, in principle, no limit to the resolution. The sensitivity of the inversion algorithm to noise and to round-off error, however, practically limits the energy resolution to several percent of the deep level defect binding energy. This resolution is an improvement by about a factor of 2 over the best resolution possible from the standard rate window techniques for which there is a finite lower bound to the temperature resolution. This lower bound depends on the capture cross-section of the defect and the effective time constant of the rate window, but is independent of the defect energy.

36099 **Time-dependent theory of hot electrons using the discrete Boltzmann equation.** Canright, G.S.; Mahan, G.D. (Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830 and Department of Physics, The University of Tennessee, Knoxville, Tennessee 37996). *Physical Review [Section] B: Condensed Matter;* **36**: No. 2, 1025-1031(15 Jul 1987).

The discrete Boltzmann equation may be applied to the time evolution of the electron distribution for spatially homogeneous systems in which optical-phonon scattering is dominant. We describe the time-dependent solution for both pulsed and steady excitation (e.g., via photoexcitation). The results for the latter case may be compared with experimental hot-electron luminescence spectra under steady photoexcitation. The agreement is generally good, but sensitive in detail to the method used to calculate recombination rates.

36100 **Nearest-neighbor frustrated random-bond model in d = 2: Some exact results.** Shankar, R.; Murthy, G. (Department of Physics, Yale University, J. W. Gibbs Laboratory, New Haven, Connecticut 06520). *Physical Review [Section] B: Condensed Matter;* **36**: No. 1, 536-545(1 Jul 1987).

We study a d = 2 Ising model where the veritcal bonds are fixed and ferromagnetic and the horizontal bonds can vary randomly in sign and in magnitude (within some limits) but are same within each now. The model therefore generalizes that of McCoy and Wu since it allows for the interesting case of frustration. We use the transfer matrix to map our problem to a collection of random field d = 1 problems about which a lot is known. We find generally three transitions: a Griffiths transition, its dual version, and one with infinite correlation length and index $\nu = 1$. In all cases the free energy has infinitely differentiable singularities. In addition there are some zero-temperature transitions.

36101 **Quantum Monte Carlo simulations of many-body phenomena in a single-impurity Anderson model.** Gubernatis, J.E. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **36**: No. 1, 394-400(1 Jul 1987).

Over a limited temperature range, we were able to simulate, with a quantum Monte Carlo method, the major many-body phenomena in a single-impurity Anderson model. These phenomena include local-moment formation, mixed-valence behavior, and the Kondo effect. For some choices of parameters we reached sufficiently low temperatures that our calculations of Tchi/sub d/ agreed with the universal Kondo-impurity susceptibility computed by the renormalization-group technique. We also calculated the correlations between the spin and charge at the impurity and those at the lattice sites. In these correlations we observed oscillations reminiscent of Ruderman-Kittel-Kasuya-Yosida and Friedel oscillations. We also discuss the possibility of extending our calculations to the two-impurity and lattice Anderson Hamiltonians.

36102 **Rebonding effects in separation and surface-diffusion barrier energies of an adatom pair.** Feibelman, P.J. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Physical Review Letters;* **58**: No. 26, 2766-2769(29 Jun 1987). Contract AC04-76DP00789.

For Al adatom pairs on Al(100), first-principles calculations imply a small separation energy of 0.07 eV, resulting from Al-surface rebonding as adatom-adatom bonds break. Calculated barriers for Al-pair and single-Al diffusion are 0.66 and 0.80 eV. The pair barrier is lower because pairs reside farther above surfaces, where potential corrugation is weaker, and because an Al surmounting a barrier gains energy from its partner, whose bond to the surface strengthens.

36103 **Double-sine-Gordon solitons: A model for misfit dislocations on the Au(111) reconstructed surface.** El-Batanouny, M.; Burdick, S.; Martini, K.M.; Stancioff, P. (Department of Physics, Boston University, Boston, Massachusetts 02215). *Physical Review Letters;* **58**: No. 26, 2762-2765(29 Jun 1987).

We demonstrate that the reconstruction of the Au(111) surface can be interpreted in terms of a new type of misfit dislocations, namely, double-sine-Gordon-type dislocations. First, we motivate the applicability of this class of solitons to the reconstruction problem. Second, we describe the procedure we have used to construct the model unit cell containing the double-sine-Gordon quasi one-dimensional dislocations. Finally, comparison with experimental He-scattering results is established by computation of the corresponding diffraction pattern using a hard corrugated wall and the eikonal approximation.

36104 **Effect of ion implantation on subsequent erosion and wear behavior of solids.** McHargue, C.J. (Oak Ridge National Lab., TN). pp 370-393 of Erosion and growth of solids stimulated by atom and ion beams. Kiriakidis, G.; Carter, G.; Whitton, J.L. (eds.). Dordrecht, Netherlands; Martinus Nijhoff (1986). (CONF-8509175—).

From North Atlantic Treaty Organization advanced study institute; Heraklion Crete, Greece (16 Sep 1985).

Ion implantation can modify many material properties either by directly affecting the deformation characteristics or indirectly by affecting the chemical or phase composition at the surface. The various forms of wear and erosion are analyzed to determine the material and system parameters which control material removal. The effects of implantation on these critical parameters are noted and examples of changes in surface topography under various test conditions are discussed. (Auth.). 52 references.

6561 Superconductivity

REFER ALSO TO CITATION(S) 35195, 35204, 35205, 35208, 35209, 35210, 35213, 35215, 35219, 35220, 35221, 35222, 35223, 35224, 35225, 35226

36105 **Hydrodynamic description of collective modes in heavy-fermion superconductors.** Rodriguez, J.P. (Loomis Laboratory of Physics, University of Illinois at Urbana-Champaign, 1110 W. Green Street, Urbana, Illinois 61801 and Center for Materials Science, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] B: Condensed Matter;* **36**: No. 1, 168-179(1 Jul 1987).

We present a hydrodynamical theory for the collective modes of a p-wave superconductor that is described by an order parameter d which transforms as a vector under rotations generated by the spin angular-momentum operator J = L+S. Such superconducting order is possible in metals with cubic, hexagonal, or tetragonal crystal symmetry whose pairing electrons experience strong spin-orbit coupling. This is true of the known heavy-fermion superconductors. The variables J and d follow a Hamiltonian dynamics that results in an internal Josephson effect between the populations of spin-up and spin-down Cooper pairs. The effect is similar to the longitudinal spin-resonance behavior observed in the superfluid phases of ^{3}He. Viscous corrections to the spin angular-momentum conservation of the pairs and to the momentum conservation of the bulk are introduced, serving to couple this Josephson mode to sound propagation. The coupling, which exists for both longitudinal and transverse sound, results in a resonant absorption contribution to the sound attenuation constant with a Lorentzian shape centered at the longitudinal spin-orbit resonance frequency. The height of this Lorentzian varies as ω^2 with frequency, characteristic of hydrodynamics, and its width depends upon frequency and the amount of quasiparticle scattering. It is suggested that this mechanism accounts for the sound absorption peak recently observed in the heavy-fermion superconductor UBe/sub 13/.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 35937, 36116, 36192

36106 **(DOE/ER/10711—6) Applied mathematics of transport theory: Final report, December 1, 1983-March 31, 1987.** Greenberg, W.; Zweifel, P.F. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Center for Transport Theory and Mathematical Physics). 1987. Contract AS05-80ER10711. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010464.

This is the final report for the subject grant. We have carried out a program of research in various areas of applied mathematics related to transport problems in kinetic theory. The term transport refers to physical problems in which the streaming aspects of the transported quantity dominate the collisional aspects, as when the mean free path in the flow exceeds the impact radius. Our work has largely been devoted to developing the theory of transport equations in an abstract setting, in order to treat systematically the large number of kinetic equations and to expand the range of equations subject to analysis, and preliminary to the study of related nonlinear systems. At the same time we have treated certain concrete models of particular physical interest, both from an analytic and from a computational point of view. We indicate below specific references to these developments.

36107 **(DOE/ER/40048—04-P7) Squeezed states and quantum-mechanical parametric amplification.** Brown, L.S. (Washington Univ., Seattle (USA). Dept. of Physics). 1986. Contract AC06-81ER40048. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011078.

The relation of a previous paper on the parametric amplification of a quantum oscillator to squeezed states is described. In particular, we show that in general the amplification factor is also the "squeezing factor" of the final state. 8 refs.

36108 **(DOE/ER/60420—1) Proceedings of the International Symposium on atomic, molecular and solid-state theory, scattering problems, many body phenomena, and computational quantum chemistry: Quantum chemistry symposium No. 20.** Loewdin, P.O.; Oehrn, N.Y.; Sabin, J.R.; Zerner, M.C. (eds.). (Wiley (John) and Sons, New York (USA)). 1986. Contract FG03-85CE90229;FG05-86ER60420. 756p. (CONF-8603121—Pt.2). John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158. File Number TI87009263.

From Special Sanibel symposium; St. Augustine, FL, USA (8 Mar 1986).

Sixty-four papers are included. Those in scope for the data base are processed separately. (DLC)

36109 **Form and intrinsic optical activity in light scattering by chiral particles.** Singham, S.B. (Life Sciences Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 3, 1873-1881(1 Aug 1987). Contract W-7405-ENG-36.

The effect of intrinsic optical activity on the scattering matrix elements of a particle with macroscopic chirality (i.e., form chirality) is examined. An extension of the coupled dipole method is used in which the optical activity of the medium is included in the dipole moments of the subunits which are arranged to describe the chiral structure. The magnitude of the difference in refractive indices of the medium for left and right circularly polarized light chosen for the calculations is realistic for biological systems. The scattering matrix elements which are sensitive to form chirality are found to be significantly changed by intrinsic optical activity of this magnitude and the effect is more important when the chiral parameters become small compared with the wavelength of light. The intrinsic optical activity has a significant effect on the circular intensity differential scattering (CIDS) of a chiral structure at forward scattering angles. The form and intrinsic contributions to CIDS are found to be additive.

36110 Is there a zeroth order time-step error in diffusion quantum Monte Carlo?. Reynolds, P.J.; Owen, R.K.; Lester W.A. Jr. (Materials and Chemical Sciences Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 3, 1905-1906(1 Aug 1987). Contract AC03-76SF00098.

It is demonstrated that the short-time Green's function often used in diffusion quantum Monte Carlo simulations of the Schroedinger equation generates an unbiased probability distribution in the limit of vanishing time step tau. For finite tau, an error is introduced into the potential which is of O(tau). An expression for this term is derived.

36111 Toward a Monte Carlo theory of quantum dynamics. Doll, J.D.; Coalson, R.D.; Freeman, D.L. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **87**: No. 3, 1641-1647(1 Aug 1987).

We consider in the present paper an extension of numerical path integral methods for use in computing finite temperature time correlation functions. We demonstrate that coordinate rotation techniques extend appreciably the time domain over which Monte Carlo methods are of use in the construction of such correlation functions.

36112 Monte Carlo path integration in real time via complex coordinates. Chang, J.; Miller, W.H. (Department of Chemistry, University of California, Materials and Molecular Research Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Journal of Chemical Physics;* **87**: No. 3, 1648-1652(1 Aug 1987). Contract AC03-76SF00098.

A method is described for Monte Carlo path integration that is valid for real time propagation. More specifically, it is shown how matrix elements of the complex-time propagator e^{-}/sup β// sup >//sup c/H$, β/sub c/ = β/2+it/h-dash-bar, can be evaluated by straightforward Monte Carlo for values t>>βh-dash-bar/2. The key feature is that one distorts the path of the integration variables so that the kinetic energy part of the integrand is real. This in turn means that the paths are complex valued, but it is shown that, at least for barrier-type potentials, this causes no difficulties.

36113 Random walk in a quasicontinuum. Doering, C.R.; Hagan, P.S.; Rosenau, P. (Center for Nonlinear Studies and Theoretical Division, MS-B258, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **36**: No. 2, 985-988(15 Jul 1987).

A continuous-time random walk on a spatial lattice described by the Kramers-Moyal expansion has a continuum limit described by a Fokker-Planck equation. It is often desirable to know corrections to quantities computed in the continuum limit, but truncation of the Kramers-Moyal expansion at any level other than the Fokker-Planck either breaks down or yields unphysical results. Here we introduce an alternative approximation to the Kramers-Moyal expansion which circumvents the problems of a naive truncation and correctly incorporates the first-order corrections due to the discrete lattice.

36114 Time-resolved and energy-resolved coded aperture images with URA tagging. Fenimore, E.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Optics;* **26**: No. 14, 2760-2769(15 Jul 1987).

Coded aperture imaging with uniformly redundant arrays (URAs) is the standard technique for imaging above the limit of grazing incident x-ray telescopes. It is an ideal technique for high energy astrophysics because it has high throughput, excellent performance on point sources, and the ability to measure simultaneously signal and background. However, many sources of interest in high energy astrophysics are time variable or require detailed energy spectra. Until now, to obtain a single time (or energy) sample, the photons from the particular time (or energy) interval must be formed into an encoded pattern, then processed to obtain an image for that sample. Therefore, massive computations are required to cover the entire time and energy parameter space. We present a new method of coded aperture analysis called URA tagging, which provides time and/or energy resolved histories of sources with known positions without using a correlation operation. It can easily reduce the computation time by orders of magnitude compared to the next fastest method, the fast delta Hadamard transform. URA tagging can also correct for improperly encoded images or motion blurred images. Whereas previous methods for quantifying performance have not taken into account the finite resolution or the quantized sampling, URA tagging provides a SNR equation that includes all such effects. URA tagging analysis explains why delta decoding has a somewhat poorer SNR than balanced correlation; naively, one expects the better angular resolution to yield a better SNR. In addition, we show that complementary URAs (exchange opaque and transparent elements) have different properties, and those with an even number of transparent elements should be preferred.

36115 Mapping from rectangular to harmonic representation. Schneider, W.; Bateman, G. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Computational Physics;* **71**: No. 1, 169-180(Jul 1987).

An algorithm is developed to determine the Fourier harmonics representing the level contours of a scalar function given on a rectangular grid. This method is applied to the problem of computing the flux coordinates and flux surface averages needed for 1½/2D transport codes and MHD stability codes from an equilibrium flux function on a rectangular grid. copyright 1987 Academic Press, Inc.

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REFER ALSO TO CITATION(S) 35400, 35400, 36056, 36153, 36157

36116 (AD-A—178738/1/XAB) Linear or nonlinear problems with input sets. II. Final report, 1 July 1984-15 October 1986. Ames, W.F. (Georgia Inst. of Tech., Atlanta (USA)). 6 Mar 1987. 11p. NTIS, PC A02/MF A01.

This research consists of a systematic search, compilation, and generation of exact explicit solutions for classes of practical nonlinear wave problems; concerns the construction of approximate solutions, with quantitative error estimates, which are generalizations of the explicit exact solutions; and concerns input sets for both data and coefficients in wave problems.

36117 (DOE/ER/53222—93) Ideal, steady-state, axisymmetric magnetohydrodynamic equations with flow. Baransky, Y.A. (Columbia Univ., New York (USA). Plasma Physics Lab.). 1987. Contract FG02-86ER53222. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87010237.

The motivation of this study is to gain additional understanding of the effect of rotation on the equilibrium of a plasma. The axisymmetric equilibria of ideal magnetohydrodynamics (MHD) with flow have been studied numerically and analytically. A general discussion is provided of previous work on plasmas with flow and comparisons are made to the static model. A variational principle has been derived for the two dimensional problem with comments as to appropriate boundary conditions. An inverse aspect ratio expansion has been used for a study of the toroidal flow equation for both low- and high-β. The inverse aspect ratio expansion has also been used for a study of equations with both poloidal and toroidal flow. An overview is provided of the adaptive finite-difference code which was developed to solve the full equations. (FI)

36118 (TRITA-PFU—86-07) Large Larmor radius effects on density perturbations in a magnetized plasma. Lehnert, B. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Jul 1986. 24p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752189.

Electrostatic perturbations are considered in a model where a plasma is situated in a homogeneous magnetic field and is subject

to an equivalent gravitation force representing the magnetic inhomogenity effects. The perturbations are strongly affected by large Larmor radius (LLR) effects when their wavelength becomes comparable to the ion Larmor radius. In the case of a dilute plasma, two time-dependent constants of the motion are found from which a solution can be deduced for the perturbations. The LLR effects are shown to 'chop up' the time development of the macroscopic density and electric fields perturbations into a pulse-shaped periodic pattern. The latter is repeated at every half of a gyro period and becomes strongly damped between a set of arising narrow peaks. In the real physical situation of plasma confined in an inhomogenous magnetic field, the corresponding field inhomogeneity is expected to produce additional LLR phase mixing effects due to the dispersion in the guiding centre drifts of the ions. The LLR effects have here been demonstrated in a simple special case, but similar results are likely to be obtained in more complicated situations, such as in denser plasmas where the electric field from the space charges affects particle dynamics. Consequently, the fine structure of a number of plasma perturbations is expected to become strongly distorted by LLR effects, and this becomes important to plasma stabilitiy. The present analysis finally shows that deductions in terms of normal modes having the time dependence exp (i/omega/t) become irrelevant in presence of LLR effects, whereas a corresponding treatment of the spatial dependence applies at least in certain cases. The LLR effects are important not only to hot laboratory high-beta plasmas, but also to the cosmical problems of dusty plasmas containing heavy charged particles.

36119 **(TRITA-PFU—86-08) Pecularities of the start-up process in a toroidal Extrap.** Tendler, M. (Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics and Fusion Research). Aug 1986. 19p. NTIS (US Sales Only), PC A02/MF A01. File Number DE87752190.

The breakdown, occuring in the EXTRAP system, in which a plasma is immersed in the purely poloidal, strongly inhomogeneous external magnetic field, is analyzed. The division into four subsequent phases of the development of these discharges is presented. It is shown that the toroidicity, the lack of electrodes and the external magnetic field strongly affects the breakdown conditions. It is emphasized that, in the presence of the external magnetic field, the internal radial electric field has to be taken into account. Two different options for the start-up scenaria are described. The discharge might either develop along the 0-line or at the periphery of the discharge. The essential parameters, which govern the development are shown to be the skin depth in the breakdown phase and the degree of the magnetization. The advantages and the disadvantages of these different scenaria are listed. It is pointed out that if the discharge starts along the 0-line the ionization might be full only in the close vicinity of this line. Methods to improve the axial homogeneity during the breakdown phase are described.

36120 **(UCLA/PPG—1053) An analytic model for flow reversal in divertor plasmas.** Cooke, P.I.H.; Prinja, A.K. (California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering). Apr 1987. Contract FG03-86ER52130. 20p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010023.

An analytic model is developed and used to study the phenomenon of flow reversal which is observed in two-dimensional simulations of divertor plasmas. The effect is shown to be caused by the radial spread of neutral particles emitted from the divertor target which can lead to a strong peaking of the ionization source at certain radial locations. The results indicate that flow reversal over a portion of the width of the scrape-off layer is inevitable in high recycling conditions. Implications for impurity transport and particle removal in reactors are discussed.

36121 **Ionization and recombination rates for argon ions Ar XII—XVI from time-resolved spectroscopy of tokamak plasmas.** Wang, J.; Griem, H.R.; Rowan, W.L. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 2, 951-954(15 Jul 1987).

The effective ionization and recombination rate coefficients Ar XII—XVI were obtained by studying the modulation of line emission by sawtooth oscillations in the Texas Experimental tokamak (TEXT). Experimental data are matched with the simulation of argon ion emission by a one-dimensional code. The rate coefficients were determined for T/sub e/—400 eV and N/sub e/—4 x 10/sup 13/ cm/sup -3/. The uncertainty of ionization rates is estimated to be less than 30%, while the accuracy of the recombination rates is better than a factor of 2.

36122 **Plasma instability in the presence of negative ions.** Johnson III, J.A.; Ramaiah, R. (Department of Physics, The City College, City University of New York, New York, New York 10031). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 2, 774-794(15 Jul 1987).

Ion density fluctuations are studied in a diffusion-controlled argon plasma containing, as a dilutant, two electron-attaching species, carbon dioxide, and sulfur hexafluoride. A glow discharge tube is used in this experiment; electrical probes and digital spectral analysis are our principal diagnostic and analytical tools. It is found that the system becomes increasingly unstable as the concentration of the electron-attaching species is increased. Nonlinear mode-mode couplings have been identified and the coupling coefficients for these interactions have been computed. Turbulent fluctuations are observed to have pronounced three dimensionality with distinct axial and azimuthal behaviors. The power spectra of these fluctuations are composed of many discrete modes and follow a P(w)proportionalw^{-}/sup n/ trend with $3 < n < 5$. The importance of changes in the total discharge pressure is dependent on the electron-attachment cross section of the dilutant species. From these results we show that the ionization instability is probably responsible for the observed phenomenon.

36123 **Phase-space—Lagrangian action principle and the generalized K-chi theorem.** Kaufman, A.N. (Physics Department and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review* [*Section*] *A: General Physics;* **36**: No. 2, 982-984(15 Jul 1987).

The covariant coupled equations for plasma dynamics and the Maxwell field are expressed as a phase-space—Lagrangian action principle. The linear interaction is transformed to the bilinear beat Hamiltonian by a gauge-invariant Lagrangian Lie transform. The result yields the generalized linear susceptibility directly.

36124 **Broadband calibration for magnetic probes for use in the Maryland spheromak.** Shaw, R.S.; Booske, J.H.; McCarrick, M.J. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Review of Scientific Instruments;* **58**: No. 7, 1204-1210(Jul 1987).

Magnetic probes are commonly used in plasma experiments to measure the magnetic and plasma properties of the configuration. Probes consisting of coils of copper wire encased in one or more layers of stainless-steel tubing are used both inside and outside the plasma to measure the magnetic field in the Maryland spheromak. A technique has been developed to calibrate the probes over a large frequency bandwidth using digital computer signal processing. The frequency-dependent effects of the stainless-steel tubing and the self-inductance of the coils on the recorded signal are taken into account over the entire bandwidth. This technique may also be used to take into account the eddy currents present in the metal vessel walls.

36125 **HAIFA: A modular, fiber-optic coupled, spectroscopic diagnostic for plasmas.** Ramsey, A.T.; Turner, S.L. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 7, 1211-1220(Jul 1987). Contract AC02-76CH03073.

HAIFA is a modular, multichannel, fiber-optically coupled spectroscopy diagnostic for tokamak plasmas. It operates in the visible, measuring H/sub α/ radiation, the visible continuum from thermal bremsstrahlung, and selected impurity lines. HAIFA is characterized by high modularity and flexibility, good radiation resistance, high noise immunity, and low cost. Details of design, construction, and calibration are given. The analysis of visible bremsstrahlung radiation measurements to deduce the effective ionic charge in a plasma is discussed.

36126 One-and-a-quarter-dimensional transport modeling of the field-reversed configuration. Werley, K.A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 7, 2129-2138(Jul 1987).

A radial time-dependent plasma transport code to be used for numerically modeling field-reversed configurations is described. The plasma model assumes two-fluid magnetohydrodynamics and includes a description of plasma on both the closed and open magnetic field lines, as well as such physics effects as axial contraction of the separatrix, flux surface averaging, and particle and energy losses along the open magnetic field lines. This code was applied to two typical discharges (5 and 20 mTorr initial fill pressures) of the FRX-C field-reversed configuration[Fusion Tech. 9, 13 (1986); Phys. Fluids 27, 1514 (1984)] experiment at Los Alamos. Simulation results and values of the transport coefficients are reported.

36127 Equilibrium studies of a poloidal divertor pinch with a reversed toroidal field. Sarff, J.S.; Sprott, J.C.; Turner, L. (Department of Physics, University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **30**: No. 7, 2155-2162(Jul 1987).

An analytic solution for the force-free magnetic field, del x B = λB, in the poloidal divertor configuration of the Tokapole II device [Nucl. Fusion 19, 1509 (1979)] is presented. Experiments conducted on Tokapole II which provide equilibrium magnetic field profile measurements using a magnetic probe are then described. Observations include a non-constant-λ profile and a large diamagnetic current near the magnetic separatrix.

36128 Particle confinement improvement during 2.45 GHz lower-hybrid current-drive experiments. Mayberry, M.J.; Chen, K.; Luckhardt, S.C.; Porkolab, M. (Plasma Fusion Center, Research Laboratory of Electronics, and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **30**: No. 7, 2288-2291(Jul 1987).

Particle confinement behavior during 2.45 GHz lower-hybrid current drive has been investigated on the Versator II tokamak [Phys. Fluids 29, 1985 (1986)]. It is found that during combined Ohmic and rf current drive the global particle confinement time tau/sub p/ increases by up to a factor of 2 compared to purely Ohmically driven discharges, as observed in earlier 800 MHz experiments at lower densities n-bar/sub e/ ≦6 x 10^{12} cm^{-3}. In the present experiments, tau/sub p/ increases have been observed at densities up to n-bar/sub e/ = 2 x 10^{13} cm^{-3}.

36129 Particle gyration in the presence of nonuniform static or oscillatory electric fields: Gyrofrequency shift and gyrophase locking. Auerbach, S.P. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **30**: No. 7, 2139-2148(Jul 1987). Contract W-7405-ENG-48.

Gyromotion is studied by applying averaging techniques to exact equations for the guiding-center position, magnetic moment, and gyrophase. A static nonuniform force F is shown to shift the gyrofrequency from Ω to ω = Ω-del/sub perpendicular/x(F/2mΩ). The effects of this gyrofrequency shift on heating are discussed, as is the prospect of experimentally observing the phenomenon. It is also shown that an oscillatory force of sufficient amplitude, whose frequency ω* is close to Ω, can cause phase locking, i.e., can force the particle to gyrate at the driving frequency ω*. A rough criterion for an electrostatic wave with electric field E to cause phase locking is that v/sub E//rhoδω≧1, where v/sub E/ =*cE/B, rho is the gyroradius, and δω = ω*-Ω. Thus a weak wave can cause phase locking if the frequency mismatch is small. Phase locking is enhanced if the magnetic field has a well, which provides a large volume over which chemical bondBchemical bond is nearly uniform. Comparison with experimental measurements on the 2XIIB magnetic mirror experiment [J. Phys., Coll. 6, Suppl. No. 12, 38, C6 (1977)] shows that phase locking may account for the puzzling observation of a highly monochromatic wave at the central cyclotron frequency.

36130 Anomalous Doppler instability during lower-hybrid current drive. Luckhardt, S.C.; Bers, A.; Fuchs, V.; Shoucri, M. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **30**: No. 7, 2110-2118(Jul 1987).

The anomalous Doppler instability is investigated for two-dimensional velocity distributions f(v/sub parallel/,v/sub perpendicular/) appropriate for lower-hybrid current drive. In this case, in contrast to the runaway electron problem, this mode becomes unstable at high density when the ratio ω²/sub p//sub e// ω²/sub c// sub e/ is sufficiently large. Increasing the maximum velocity v_2 of the rf (radio-frequency) plateau, $v_1 \leqq v/sub\ parallel/ \leqq v_2$, is also a destabilizing influence. In this paper expressions are given for the growth rate of the electrostatic waves obeying the dispersion relation ω = ω/sub p//sub e/ (1+ω²/sub p//sub e// ω²/sub c//sub e/)⁻¹/sup //² k/sub parallel//k, employing both analytic expressions for f(v/sub parallel/,v/sub perpendicular/) and numerical solutions for f from the two-dimensional Fokker—Planck equation. The analytical and numerical results are in close agreement.

36131 Fast crash of the central temperature during sawteeth in tokamaks. Kleva, R.G.; Drake, J.F.; Denton, R.E. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Physics of Fluids;* **30**: No. 7, 2119-2128(Jul 1987).

A simple model of the crash phase of sawteeth in tokamaks is presented, which explains many of the significant experimental observations: small oscillations in the electron temperature prior to the crash (precursor), a short crash time, and large long-lived oscillations in the electron temperature following the crash (successor). In tokamak discharges with good central confinement the temperature profile across the center of the discharge remains rather flat. In such profiles skin currents form that cause the safety factor q to fall below one at a finite radius r/sub s/ while q(r = 0)≅1. The sawtooth crash is caused by the m = n = 1 tearing mode growing on such a profile. For a profile in which q falls below one by an amount Δq, the crash time is given by the helical Alfven time tau/sub A//Δq, independent of the resisitivity. The size of the magnetic island of the precursor can be a small fraction of r/sub s/. In contrast, a remnant magnetic island of the order of r/sub s/ survives the crash and causes the successor oscillation. Estimates of the decay time of the successor are given.

36132 Magnetohydrodynamic stability of hot-electron stabilized tandem mirrors. Dobrott, D.; Kendrick, S.; Freis, R.P.; Cohen, B.I. (Science Applications International Corporation, La Jolla, California 92037). *Physics of Fluids;* **30**: No. 7, 2149-2154(Jul 1987).

The influence of energetic electron rings, or disks, on the magnetohydrodynamic stability of an axisymmetric tandem mirror configuration is studied. Linear stability equations describing interchange and ballooning modes are solved both analytically and numerically using a two-dimensional stability code for axisymmetric mirrors. Finite-ion-Larmor-radius effects and the presence of a lateral wall are included in the calculations. Stable configurations can be obtained with either sufficiently high hot-electron pressure or with sufficiently high center-cell pressure if a lateral conducting wall is close enough to the plasma. In particular, hot electrons might be used to stabilize transiently the plasma during buildup to a high-beta, wall-stabilized configuration.

36133 Local magnetohydrodynamic instabilities of cylindrical plasma with sheared equilibrium flows. Bondeson, A.; Iacono, R.; Bhattacharjee, A. (Centre de Recherches en Physique des Plasmas, Association Euratom—Confederation Suisse, Ecole Polytechnique Federale de Lausanne, 21, Av. des Bains, CH-1007 Lausanne/Switzerland). *Physics of Fluids;* **30**: No. 7, 2167-2180(Jul 1987).

The ideal magnetohydrodynamic stability of cylindrical equilibria with mass flows is investigated analytically and numerically. The flows modify the local (Suydam) criterion for instability at the resonant surfaces where kxB = 0. Sheared flows below the propagation speed for the slow wave are found to be destabilizing for the Suydam modes. At a critical velocity, where the shear of the flow exactly balances the propagation of the slow wave along the

sheared magnetic field, and the kxB = 0 surface is at the edge of a slow wave continuum, there is instability regardless of the pressure gradient. Above the critical velocity, the kxB = 0 surface is stable, but an infinite sequence of unstable modes still exists with frequencies accumulating toward the edge of the slow wave continuum at nonzero Doppler shifted frequency. The stability of the infinite sequences becomes a nonlocal problem whenever the accumulation frequency overlaps with a continuum at some other radial location.

36134 **Particle-in-cell simulations of azimuthal instabilities in relativistic electron layers.** Gisler, G.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 7, 2199-2208(Jul 1987).

Negative-mass and cyclotron-maser instabilities in electron rings or layers lead to breaking of the azimuthal symmetry. The short-wavelength modes are generally thought to be harmless since they saturate by increasing the thickness and energy spread of the original layer. The long-wavelength (or low-order) modes, on the other hand, can be devastating to the integrity of the layer. Linear theory has predicted that the growth rates for negative-mass instability modes are proportional to th azimuthal mode number, so that the low-order modes would not be important until quite late in time. In contrast, the simulations presented here show that low-order modes can arise quite early in time, out of nonlinear states of the high-order modes. At low currents, azimuthal instabilities can be effectively suppressed (as predicted by linear theory) by starting out with a thicker layer, with the particle energy varying with radius. The dispersion in circulation frequency so introduced effectively damps all growing waves. Unfortunately, at high currents (field reversal factors zetaapprox. >2%), making the layer thicker does not help. All growth rates are faster at the higher densities, and the high mode numbers grow to substantial amplitudes before damping is effective. Beating of nearby high-order modes gives rise to global modes that destroy the layer within a few rotations.

36135 **Contribution to half-harmonic splitting resulting from Raman backscattering in a rippled plasma.** Figueroa, H.; Joshi, C. (University of California, Los Angeles, California 90024). *Physics of Fluids;* **30**: No. 7, 2294-2296(Jul 1987).

The dispersion relation of electron plasma waves in a rippled plasma is analyzed. The ripple couples the plasma wave to its spatial harmonics thereby introducing "forbidden" frequency bands. It is shown that the stimulated Brillouin scattering (SBS) induced ripple can directly influence the frequency matching condition for Raman near the quarter-critical density and thereby lead to an asymmetric splitting of the half-harmonic radiation. The predicted blue-shifted peak is found to be more sensitive to the ripple amplitude than the red-shifted peak. This mechanism may contribute to the half-harmonic splitting that is observed in many experiments.

36136 **Second-harmonic layer of an obliquely propagating extraordinary wave in a tokamak.** Matsuda, K. (GA Technologies, Inc., San Diego, California 92138). *Physics of Fluids;* **30**: No. 7, 2291-2294(Jul 1987).

Differences in dispersion curves around the second-harmonic electron-cyclotron frequency obtained for a complex k/sub perpendicular/ and for a complex ω are investigated for an obliquely propagating extraordinary wave. The differences found in this study indicate the need for a full wave theory to predict the angular dependence of heating efficiency.

36137 **Measurement of the rotational transform at the axis of a tokamak.** West, W.P.; Thomas, D.M.; deGrassie, J.S.; Zheng, S.B. (GA Technologies Inc., San Diego, California 92138). *Physical Review Letters;* **58**: No. 26, 2758-2761(29 Jun 1987).

Measurements of the internal magnetic field structure of Texas Experimental Tokamak discharges are made by use of laser-induced fluorescence of an injected Li^0 beam. From measurements near the magnetic axis, we obtain the axial safety factor, q_0 (or equivalently the rotational transform, iota = $2\pi/q$) for various discharge conditions. In particular, for low-q/sub a/ sawtoothing discharges, we find time-averaged values of q_0 significantly less than 1 (—0.7 to 0.8), in contrast with models used to describe the nonlinear internal relaxation process commonly known as sawteeth.

36138 **Coupled model of wave damping, quasilinear heating, and radial transport applied to bumpy tori.** Batchelor, D.B.; Carter, M.D.; Chen, G.L.; Hedrick, C.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review Letters;* **58**: No. 25, 2664-2667(22 Jun 1987). Contract AC05-84OR21400.

A simple Fokker-Planck model of rf heating is presented which includes quasilinear velocity diffusion, collisions, and particle transport by radial collisional diffusion and direct-drift losses. In addition, the influence of the incident-wave electric-field spatial profile on the velocity-space structure of the quasilinear operator and, in turn, the effect of the nonlinear distribution function on the wave field are included. Application is made to electron-cyclotron heating in the Elmo bumpy torus.

36139 **Rayleigh-Taylor instability growth rates in targets accelerated with a laser beam smoothed by induced spatial incoherence.** Grun, J.; Emery, M.H.; Manka, C.K.; Lee, T.N.; Mclean, E.A.; Mostovych, A.; Stamper, J.; Bodner, S.; Obenschain, S.P.; Ripin, B.H. (Naval Research Laboratory, Washington, DC 20375). *Physical Review Letters;* **58**: No. 25, 2672-2675(22 Jun 1987).

Growth rates of the Rayleigh-Taylor instability in foils accelerated with a laser beam smoothed by induced spatial incoherence were measured and compared with hydrodynamic code simulations. Modes with 150- and 100-μm wavelengths grew at predicted rates. However, no growth was experimentally observed at a 50-μm wavelength. Code simulations suggest that induced spatial incoherence can influence the 50-μm Rayleigh-Taylor mode by delaying the start of its growth.

36140 **Nonlinear coupling of stimulated Raman and Brillouin scattering in laser-plasma interactions.** Rose, H.A.; DuBois, D.F.; Bezzerides, B. (University of California, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **58**: No. 24, 2547-2550(15 Jun 1987).

Detailed agreement with the experiments of Walsh, Villeneuve, and Baldis is obtained from a theory of the coupling of stimulated Raman scattering and stimulated Brillouin scattering which incorporates the nonlinear physics of the Zakharov model.

36141 **Turbulent magnetic diffusion and magnetic field reversal.** Hameiri, E.; Bhattacharjee, A. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **30**: No. 6, 1743-1755(Jun 1987).

The behavior of compressible plasmas caused by small fluctuations superimposed on slowly varying profiles is investigated self-consistently within the framework of resistive magnetohydrodynamics. The effect of the fluctuations is shown to be the generation of an additional "eddy" resistivity, and not of a dynamo. This effect, nevertheless, suffices to explain magnetic field reversal in pinches. The functional form of the turbulent resistivity is derived from the dynamics of the fluctuations, taken as a bath of local and global modes that are believed to be responsible for field reversal. It is shown that the fluctuations tend to flatten the pressure and parallel current profiles and thus produce plasmas near a "Taylor state."

36142 **Interchange stabilization of an axisymmetric single cell mirror using high-frequency electric fields.** Ferron, J.R.; Golovato, S.N.; Hershkowitz, N.; Goulding, R. (University of Wisconsin, Madison, Wisconsin 53706). *Physics of Fluids;* **30**: No. 6, 1869-1884(Jun 1987).

Stabilization of interchange instabilities in the Phaedrus tandem mirror [Phys. Rev. Lett. 51, 1955 (1983)] through the use of externally applied RF at a single frequency is demonstrated over a wide range of frequency (1.03Ω/sub i/ <ω<4.1Ω/sub i/). Here RF stabilized plasmas are reported with ion temperature up to 550 eV and beta up to 8%. Calculations of the RF electric fields show that the dominant mode is the m = +1 fast wave. When the RF frequency is near Ω/sub i/ the calculated ponderomotive forces on ions and electrons are shown to be comparable. For ω>1.3Ω/sub i/ it is shown that the force acts primarily on electrons. Stable plas-

mas are only achieved when the net radial ponderomotive force is calculated to be stabilizing and comparable to the curvature force. Results are also reported for RF applied simultaneously at two frequencies, one which is stabilizing and one which is destabilizing. Abrupt changes in stability are observed as the RF power is increased whenever one of the RF frequencies is effective at plasma heating.

36143 **Asymmetric magnetic flux generation, m = 1 activity, and edge phenomena on a reversed-field pinch.** Howell, R.B.; Ingraham, J.C.; Wurden, G.A.; Weber, P.G.; Buchenauer, C.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **30**: No. 6, 1828-1838(Jun 1987).

The ZT-40M [Fusion Tech. 8, 1571 (1985)] reversed-field pinch has been used to study magnetic flux perturbations during high-θ [θ = B/sub θ/(a)/<B/sub phi/>>1.6] discharges. Asymmetric toroidal magnetic flux perturbations are found to be associated with magnetic flux emerging through the toroidal shell gap and with m = 0 magnetic disturbances moving toroidally. Ramping current discharges, which are a special case of high-θ operation, show the most robust self-generation of toroidal flux. The electron density fluctuations on the inside major radius and associated m = 1 and m = 0 fluctuations seen on edge magnetic field probes provide a clearer picture of activity during a soft x-ray sawtooth crash. During the sawtooth crash, significant magnetic energy is apparently converted into kinetic energy of the particles.

36144 **Diamagnetic wells in axisymmetric mirrors.** Hedrick, C.L.; Owen, L.W.; Quon, B.H.; Dandl, R.A. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **30**: No. 6, 1860-1868(Jun 1987). Contract AC05-84OR21400.

Here the question of whether hot-electron rings have reversed gradients in B and contour-integral dl/B in symmetric mirrors is reexamined. The focal point for this reexamination is a particular data set from a symmetric mirror device. Using standard least-squares fitting techniques, this and three other cases (having comparable stored energy) have been fitted with a five-parameter function for the perpendicular pressure. Three of the four cases show reversal of the gradients. All cases pass standard tests for goodness of fit. The probable errors, deduced by fitting a total of ten experimintal data sets, were found to be consistent with the single-measurement accuracy. Sensitivity tests for random and systematic error were performed. The errors would have to be implausibly high in order to change the conclusions regarding gradient reversal. More complex functions for the perpendicular pressure, involving more parameters, have been examined to see if radial asymmetries or pressure pedestals extending to large radius are indicated by the data and whether such hypotheses change the conclusions about gradient reversal. They do not. It is concluded that gradient reversal occurs in symmetric mirrors.

36145 **Kolmogorov's constant and local interactions.** Kraichnan, R.H. (303 Potrillo Drive, Los Alamos, New Mexico 87544). *Physics of Fluids;* **30**: No. 6, 1583-1585(Jun 1987).

Suppose that all the wave-vector triad interactions that involve no wavenumber ratio that exceeds β are removed from the Navier—Stokes equation. Within a class of closures, the paradoxical effect is to enhance energy cascade through the Kolmogorov inertial range for 1<β<β/sub c/, where β/sub c/ may be as large as 8. This may have implications with regard to force-free structures in the true Navier—Stokes dynamics.

36146 **Viscous resistive magnetic reconnection.** Porcelli, F. (Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physics of Fluids;* **30**: No. 6, 1734-1742(Jun 1987).

A unified linear analysis of viscous effects on resistive internal kink and tearing modes in current carrying magnetized plasmas is presented. The plasma is modeled by single-fluid magnetohydrodynamic (MHD) equations extended to include the dissipative processes caused by finite cross-field viscosity (μ/sub perpendicular/) and parallel electrical resistivity (eta/sub parallel/). Two parameters suffice to characterize the relevant instability regimes: the ideal stability parameter Λ/sub H/, which is proportional to the minimum value of the energy functional δW, and the viscosity parameter Vproportionalμ/sub perpendicular//eta/sub parallel/. Both positive and negative values of Λ/sub H/ are considered to simulate the effect of varying the geometry of the plasma. Analytic expressions are found using generalized Fourier techniques for the mode structure and growth rate for arbitrary values of Λ/sub H/ and V. Within the scope of the present model, the transverse viscosity slows down the growth of the linear mode, but it does not remove the instability. Novel instability regimes are investigated. For moderate values of the plasma viscosity parameter (V < 1), the most important effect is on tearing modes, where the usual ordering for the mode growth rate γ—eta/sup 3/5//sub parallel/ is modified into γ—eta/sup 5/6//sub parallel/μ/sup -1/6//sub perpendicular/, while the width of the viscous-resistive layer is found to scale as δ—eta/sup 1/6//sub parallel/μ/sup 1/6//sub perpendicular/.

36147 **Stability of ideal and resistive internal kink modes in toroidal geometry.** Hastie, R.J.; Hender, T.C.; Carreras, B.A.; Charlton, L.A.; Holmes, J.A. (Culham Laboratory (EURATOM/UKAEA Fusion Association), Abingdon, Oxon, OX14 3DB, United Kingdom). *Physics of Fluids;* **30**: No. 6, 1756-1766(Jun 1987).

The stability of the ideal and resistive m = 1 internal modes is investigated for tokamak equilibria having a variety of different q(r) profiles, including nonmonotonic q(r) with multiple q = 1 surfaces. Detailed comparisons between analytic theory and numerical results from a linear toroidal magnetohydrodynamic code are presented. Particular attention is paid to the study of equilibria that are near marginal stability.

36148 **Measurements of beam-ion confinement during tangential beam-driven instabilities in a bean tokamak experiment.** Heidbrink, W.W.; Kaita, R.; Takahashi, H.; Gammel, G.; Hammett, G.W.; Kaye, S. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **30**: No. 6, 1839-1852(Jun 1987).

During tangential injection of neutral beams into low-density tokamak plasmas with β>1%, instabilities are observed that degrade the confinement of beam ions. Neutron, charge-exchange, and diamagnetic loop measurements are examined in order to identify the mechanism or mechanisms responsible for the beam-ion transport. The data suggest a resonant interaction between the instabilities and the parallel energetic beam ions. Evidence for some nonresonant transport also exists.

36149 **Self-consistent study of a perpendicular collisionless and nonresistive shock.** Lembege, B.; Dawson, J.M. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* **30**: No. 6, 1767-1788(Jun 1987).

Particle dynamics and field behavior associated with a perpendicular collisionless supercritical and viscous shock are investigated by use of numerical simulation. A one-dimensional, relativistic, fully electromagnetic and nonperiodic particle simulation code (for both electrons and ions) is used where self-consistent space-charge effects and induced effects are totally included. The principal field patterns of the shock (trailing wave train, ramp, and foot region) are studied in detail and are shown to have scale lengths mainly dictated by ion dynamics; the behavior of the corresponding plasma currents associated with the different field components is also presented. Ions are shown to suffer successive "acceleration—trapping—detrapping" at the shock front, and locally in the trailing wave train of the downstream region through combined effects of the electrostatic and magnetic fields. While detrapped, the reflected ions describe very large Larmor orbits and cause a ring distribution; a large rapid nonstochastic ion heating results from this ion gyration. This heating (resistivity-free) is the main source of dissipation and is responsible for large field damping. Competitive effects such as particle stochasticity, particle trapping, wave damping, wave overtaking, and dispersion effects are shown to interact with each other and to affect the overall dissipation mechanism. Comparison with previous works is also discussed. Various Mach number situations are considered, leading to the definition of a tran-

sitory regime between subcritical and supercritical regimes and of a corresponding critical threshold of the electrostatic field. In contrast with the supercritical regime, the subcritical regime is characterized by a low density of trapped-reflected ions, a broad ion distribution function with a weak tail, and a weak adiabatic bulk ion heating.

36150 RF stabilization of ballooning modes in tokamaks. D'Ippolito, D.A.; Myra, J.R.; Francis, G.L. (Plasma Research Institute, Science Applications International Corporation, Boulder, Colorado 80302). *Physical Review Letters;* 58: No. 21, 2216-2219(25 May 1987).

The use of radio frequency waves in the ion cyclotron range of frequencies is shown to stabilize ballooning modes in tokamaks when the frequency and spatial wave structure are appropriately chosen. The physics of RF stabilization may provide access to high-beta tokamak operation in the second stability regime and may also be useful in the suppression of edge-localized modes in present experiments. Estimates of the required ion cyclotron range of frequencies power are given for two examples of RF stabilization.

36151 Theory of resistive magnetohydrodynamic instabilities excited by energetic trapped particles in large-size tokamaks. Biglari, H. Princeton, NJ; Princeton Univ. (1987). 175p. University Microfilms Order No. 87-04,592.

Thesis (Ph. D).

A theory describing excitation of resistive magnetohydrodynamic instabilities due to a population of energetic particles, trapped in region of adverse curvature on energetic particles, trapped in region of adverse curvature in tokamaks, is presented. Theory's principal motivation is observation that high magnetic-field strengths and large geometric dimensions characteristic of present-generation thermonuclear fusion devices, places them in a frequency regime whereby processional drift frequency of auxiliary hot-ion species, in order of magnitude, falls below a typical inverse resistive interchange time scale, so that inclusion of resistive dissipation effects becomes important. Destabilization of the resistive internal kink mode by these suprathermal particles is first investigated. Using variational techniques, a generalized dispersion relation governing such modes, which recovers ideal theory in its appropriate limit, is derived and analyzed using Nyquist-diagrammatic techniques. An important implication of theory for present-generation fusion devices is that they will be stable to fishbone activity. Interaction of energetic particles with resistive interchange-ballooning modes is taken up. A population of hot particles, deeply trapped on adverse curvature side in tokamaks, can resonantly destabilize resistive interchange mode, which is stable in their absence because of favorable average curvature. Both modes are different from their usual resistive magnetohydrodynamic counterparts in their destabilization mechanism.

36152 Laser diagnostics of radio frequency discharges. Gottscho, R.A. (AT and T Bell Labs., Murray Hill, NJ 07974). pp 52-56 of Topical meetings on lasers in materials diagnostics (Summaries). Washington, DC; Optical Society of America (1987). (CONF-870220—).

From Southwest optics conference; Albuquerque, NM, USA (9 Feb 1987).

WE1.

Recent applications of laser spectroscopy to the study of plasma and plasma-surface processes are reviewed. Using laser-induced fluorescence and optogalvanic spectroscopy, measurements of concentration gradients, reaction probabilities, electric fields, and process end-points have helped to elucidate plasma-chemical mechanisms.

7002 Fusion Power Plant Technology

REFER ALSO TO CITATION(S) 34598, 35174, 35388, 35525, 35525, 36096

36153 (IAEA-CN—47/I-I-6) Pellet fueling of JET plasmas during ohmic, ICRF and NBI heating. Gondhalekar, A.; Cheetham, A.; Bures, M.; Campbell, D.; Cohen, S.A.; Cordey, G.; Corti, S.; Edwards, A.; Ehrenberg, J.; Gill, R. (Oak Ridge National Lab., TN (USA); JET Joint Undertaking, Abingdon (UK)). 1986. Contract AC05-84OR21400. 8p. (CONF-861106—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87008812.

From IAEA international conference on plasma physics and controlled nuclear fusion research; Kyoto, Japan (12 Nov 1986).

Pellet fueling experiments have been performed on JET using a single-shot pneumatic injector giving 4.6mm (4.5 x 10^{21} D atoms) and 3.6mm (2.2 x 10^{21} D atoms) diameter cylindrical deuterium pellets with velocity $0.8 \leqq V(km.s^{-1}) \leqq 1.2$. Z/sub eff/ < 1.5 with n/sub D//n/sub e/ ~ 1 on axis has been achieved. In configurations with a magnetic seperatrix, peaked electron density profiles with n/sub e/(o)/anti n/sub e/ ~ 2 are obtained, with n/sub e/(0) ≅ 1.2 x $10^{20}m^{-3}$ and T/sub e/(0) ≅ 1keV. Separately, high value of n/sub D/(0)tau/sub E/T/sub i/(0) = 1.3 x $10^{20}m^{-3}$.s.keV at T/sub i/90) = 6.5keV has been obtained with pellet fueling followed by NBI heating.

36154 (LBL—22387) Tranverse-field focussing beam transport experiment. Kwan, J.W.; Ackerman, G.D.; Anderson, O.A.; Chan, C.F.; Cooper, W.S.; Soroka, L.; Steele, W.F. (Lawrence Berkeley Lab., CA (USA)). Oct 1986. Contract AC03-76SF00098. 13p. (CONF-8610115—25). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010283.

From 4. international symposium on the production and neutralization of negative ions and beams; Upton, NY, USA (27 Oct 1986).

The Transverse-Field Focussing (TFF) beam transport and accelerator system developed at LBL is useful for negative-ion - based neutral beam injection due to its unique differential pumping and neutron shielding properties. We have tested the first module of our TFF system transporting H^- beams up to 80 keV beam energy. The testing addressed the most crucial physics and engineering issues involved in the principles of a TFF system including beam compression and differential gas pumping. At optimum perveance, the present design will transport 4 A/m of H^- beam at 80 keV beam energy.

36155 (MLM—3429(OP)) Treatment and disposal of tritium containing waste at Mound. Rogers, M.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 16p. (CONF-870410—20). NTIS, PC A02. File Number DE87009198.

From 193. national meeting of the American Chemical Society; Denver, CO, USA (5 Apr 1987).

First generation fusion machines will burn the hydrogen isotopes deuterium and tritium as fuel. Tritium, which is radioactive, must be handled carefully and any byproducts must be disposed of as radioactive waste. Tritiated waste will fall into one of three categories: gaseous, liquid, or solid. Sources and expected quantities of tritiated waste that are likely to be generated by a fusion machine are discussed. Strategies, options and processes for dealing with tritium containing wastes are presented. Final disposition of each category of tritium contaminated waste is governed by regulations and guidelines. These regulations and guidelines, and how they might apply to a fusion reactor facility, are outlined.

36156 (SAND—87-0249C) Characterization of a graphite-OFHC [Oxygen Free High Conductivity] copper braze joint. Hosking, F.M.; Semarge, R.E.; Hills, C.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 11p. (CONF-870725—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87005880.

From 22. annual meeting of the Microbeam Analysis Society; Kailua-Kona, HI, USA (13 Jul 1987).

Fabrication of actively cooled limiter blades for magnetic confinement fusion devices requires joining graphite tiles to copper substrates. Brazing graphite to copper with active braze alloys is a promising approach since it reduces the number of steps necessary to make the assembly. The subsequent braze structure and reaction phase at the graphite/braze interface is of special interest and is discussed in this study.

36157 **Multiple track Doppler-shift spectroscopy system for TFTR neutral beam injectors.** Kamperschroer, J.H.; Kugel, H.W.; Reale, M.A.; Hayes, S.L.; Johnson, G.A.; Lowrance, J.L.; Shah, P.A.; Sichta, P.; Sleaford, B.W.; Williams, M.D.; and others. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Review of Scientific Instruments;* **58**: No. 8, 1362-1368(Aug 1987). Contract AC02-76CH03073.

A Doppler-shift spectroscopy system has been installed on the TFTR neutral beam injection system to measure species composition during both conditioning and injection pulses using short and long pulse ion sources. Two intensified vidicon detectors and two spectrometers are utilized in a system capable of resolving data from up to 12 ion sources simultaneously. By imaging the light from six ion sources onto one detector, a cost-effective system has been achieved. Fiber optics are used to locate the diagnostic in an area remote from the hazards of the tokamak test cell allowing continuous access, and eliminating the need for radiation shielding of electronic components. Automatic hardware arming and interactive data analysis allow beam composition to be computed between tokamak shots for use in analyzing plasma heating experiments. Measurements have been made using lines of sight into both the neutralizer and the drift duct. Analysis of the data from the drift duct is both simpler and more accurate since only neutral particles are present in the beam at this location. Comparison of the data taken at these two locations reveals the presence of partially accelerated particles possessing an estimated 1/e half-angle divergence of 15° and accounting for up to 30% of the extracted power from the short pulse ion sources. Operation with long pulse ion sources indicates a higher atomic composition, fewer partially accelerated particles, and somewhat reduced neutralization line densities.

36158 **Effects on H^- production in a multicusp ion source by mixtures of H_2 with H_2O, NH_3, CH_4, N_2H_4, and SF_6.** Orient, O.J.; Chutjian, A.; Leung, K.N. (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California 91109). *Journal of Applied Physics;* **62**: No. 2, 397-401(15 Jul 1987).

Effects of H^- production in a multicusp ion source are measured by separately mixing with hydrogen small amounts (0.33%—10%) of water, ammonia, methane, and hydrazine: molecules which produce large amounts of H^- via dissociative attachment (DA) resonances at higher electron energies. The mixing was done in a separate reservoir, with careful measurement of individual pressures. Experimental enhancements of 1.4 and less were observed, whereas calculated enhancements, using accurate DA cross sections for ground-state H_2, should have produced factors of 1.5, 3.0, 1.3, and 2.4 enhancements for water, ammonia, methane, and hydrazine, respectively, at a mean electron energy of 1.0 eV in the extraction region. The difference is accounted for by including, in the enhancement calculation, vibrationally and rotationally excited H_2 molecules, with $v'' = 5$—11, and $J'' = 0$—5, and the large DA cross sections for the excited $H_2(v'',J'')$. The relative populations of $H_2(v'',J'')$ thus obtained are found to be substantially smaller than those predicted by theoretical calculations. The effect on H^- current was also studied by mixing small amounts of SF_6 with H_2. A 1.5% mixture was found to reduce the H^- output by one half.

36159 **Plasma surface interactions in compact ignition devices.** Ulrickson, M.; Cecchi, J.L.; Lipschultz, B. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2257-2262(Jul 1987).

Owing to their small size compact ignition devices offer the potential of studying the physics of ignited plasma with only a relatively small capital outlay. The penalty for the small size is that the limiter/divertor heat loads are high due to the high energy density and the small surface area of these devices. The large amount of stored energy also implies that disruption effects will be very severe. Since the distance between the divertor and the plasma is minimized, careful attention must be paid to impurity generation. Hence erosion becomes a critical issue. Another important issue is that of particle handling, since the machine operates at high density. These issues of heat loads, disruptions, impurity generation, and particle handling will be discussed in this paper.

36160 **Effects of the plasma-wall sheath on transport.** Mandrekas, J.; Singer, C.E.; Ruzic, D.N. (University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2315-2318(Jul 1987).

The 1 (1)/(2) -dimensional plasma transport code BALDUR, along with the neutral transport code DEGAS are used to study the effects of secondary and photoelectron emission from the wall and limiters of a tokamak on the plasma transport. Since different electron emission mechanisms appear to be dominant in different parts of the scrapeoff, the two-region scrapeoff model included in BALDUR is particularly useful. The effect that secondary and photoelectron emission have on recycling through the reduction of the sheath potential is taken into account in DEGAS by prescribing appropriate values of the sheath potential on each recycling surface, according to the dominant electron emission mechanism present. Results indicate that when photoelectron emission from the first wall increases, the ion and electron temperatures increase in the scrapeoff, while they remain unaffected near the center. When the secondary electron coefficient of the limiters is increased, the ion and electron temperatures drop in the scrapeoff while they increase near the center. In both cases the neutral density decreases slightly throughout the device.

36161 **Diagnosing high-reliability, low-jitter Marx generators.** Lockwood, G.J.; Schneider, L.X.; Neyer, B.T.; Ruggles, L.E. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Review of Scientific Instruments;* **58**: No. 7, 1297-1302(Jul 1987). Contract AC04-76DP00789.

We have made photonic measurements to assess the performance of a bipolar Marx generator. Measurements of the switch-closing sequence were made with a high-speed multichannel data recorder using fiber optics to monitor the light produced by each switch closure. Experience gained during this research coupled with computer simulations has led to a fundamental understanding of the operation of these multistage devices. As a result of this research, significant improvement in erection time jitter has been realized. Erection time jitter has been measured as low as 2.6 ns for a 3.2-MV, 16-stage PBFA-I Marx generator. Photonic data are presented from this research program, along with a discussion on the use of computer simulations and photonic measurements in designing low-jitter Marx generators.

36162 **Development of a hydrogen electrothermal accelerator for plasma fueling.** Schuresko, D.D.; Milora, S.L.; Combs, S.K.; Foust, C.R.; Argo, B.E.; Barber, G.C.; Foster, C.A.; Ponte, N.S. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2194-2197(Jul 1987). Contract AC05-84OR21400.

We have developed a prototype high-velocity pneumatic pellet injector that uses hydrogen plasma propellant generated in a high-current arc discharge. A single-barrel pneumatic pellet gun has been fitted with a cylindrical arc chamber interposed between the hydrogen propellant inlet valve and the gun breech. The chamber incorporates a ceramic insert for generating vortex flow in the incoming gas stream, which provides azimuthal arc stabilization. The arc is initiated after the propellant valve opens and the breech pressure starts to rise; a typical discharge lasts 150—300 μs with peak currents up to 2 kA. The gun has been operated with 4-mm-diam, 6- to 11-mm-long deuterium and hydrogen pellets. At 100-bar plenum pressure (hydrogen propellant), the arc characteristics are $\langle V \rangle = 350$—800 V, $\langle I \rangle = 600$ A, so that 60—150 J of electrical power is dissipated. Pellet speeds increase by 300 to 600 m/s depending on the projectile mass, which typically represents a 10-J increment in the pellet kinetic energy. Velocities up to 1.7 km/s for deuterium pellets and 2.0 km/s for hydrogen pellets have been

achieved. Comparing these data to muzzle velocities calculated from idealized one-dimensional compressible flow gun theory demonstrates that substantial propellant heating, resulting in increased propellant sound speed, has been achieved.

36163 Gas fueling with an axisymmetric magnetic divertor in the Tara tandem mirror. Post, R.S.; Brau, K.; Horne, S.; Casey, J.; Golovato, S.; Sevillano, E.; Shuy, G.; Smith, D.K. (MIT Plasma Fusion Center, Cambridge, Massachusetts 02139). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2198-2201(Jul 1987). Contract AC02-78ET51013.

An axisymmetric divertor has been installed at the central cell midplane of Tara to provide magnetohydrodynamics stability and to generate a high-density halo at the edge of the plasma. A dense halo aids sloshing ion buildup in the plug cells and increases shielding of the core plasma from charge exchange recombination. Separate gas fueling of the halo in the divertor allows for the different fueling requirements of the potential-confined core plasma and the flow-confined edge during plugged operation.

36164 Hydrogen isotope retention and release from copper. Wilson, K.L.; Causey, R.A.; Baskes, M.I.; Kamperschroer, J. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2319-2324(Jul 1987). Contract AC04-76DP00789.

The Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory is considering the use of tritium neutral beams during the deuterium—tritium phase of operation in 1990. A concern is the tritium inventory that will develop in neutral beam components such as the copper calorimeter. In this paper we report on measurements and calculations of hydrogen isotope retention and release for copper under ion bombardment. Retention of deuterium trapped in the near-surface region is measured as a function of temperature using the D(^{3}He, p) α nuclear reaction technique with an 800-keV $^3He^+$ analysis beam. The rate of molecular recombination (K/sub r/) at the copper—vacuum interface is determined from plasma driven permeation studies in our Tritium Plasma Experiment facility. The measurements indicate that K/sub r/ = 6.7 +- 0.1 x 10^{-18} cm^4/s over the temperature range 575—825 K, in agreement with theory. These data are used as inputs to the d-smcapsIf-smcapsf-smcapsu-smcapss-smcapse-smcaps computer code to provide a model for tritium—copper interactions. The model is tested against measured pressure rises during discharges in the TFTR neutral beam line, and is then used to predict tritium inventory in the copper ion beam dumps during future TFTR tritium operation.

36165 Eight-shot pneumatic pellet injection system for the tokamak fusion test reactor. Combs, S.K.; Milora, S.L.; Foust, C.R.; Baylor, L.R.; Barber, G.C.; Burris, R.D.; Fisher, P.W.; Foster, C.A.; Lunsford, R.V.; Schmidt, G.L. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **58**: No. 7, 1195-1203(Jul 1987). Contract AC05-84OR21400.

An eight-shot pneumatic pellet injection system has been developed for plasma fueling of the tokamak fusion test reactor (TFTR). The active cryogenic mechanisms consist of a solid hydrogen extruder and a rotating pellet wheel that are cooled by flowing liquid-helium refrigerant. The extruder provides solid hydrogen for stepwise loading of eight holes located circumferentially around the pellet wheel. This design allows for three different pellet diameters: 3.0 mm (three pellets), 3.5 mm (three pellets), and 4.0 mm (two pellets) in the present configuration. Each of the eight pellets can be shot independently. Deuterium pellets are accelerated in 1.0-m-long gun barrels with compressed hydrogen gas (at pressures from 70 to 105 bar) to velocities in the range 1.0—1.5 km/s. The pellets are transported to the plasma in an injection line that incorporates two stages of guide tubes with intermediate vacuum pumping stations. A remote, stand-alone control and data-acquisition system is used for injector and vacuum system operation. The eight-shot injection system has been installed and operated on TFTR. The design features, operation, and performance characteristics of the system are described.

36166 Thermally induced behavior of liquid mixtures of hydrogen isotopes inside a spherical inertial confinement fusion target. Varadarajan, V.; Kim, K.; Bernat, T.P. (Fusion Technology Laboratory, University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2750-2754(Jul 1987).

A theory is presented which is intended to explain thermally induced formation of uniform liquid layers of ternary mixtures of hydrogen isotopes inside a spherical inertial confinement fusion (ICF) target. The governing equations are the equations of stream function, modified vorticity, and energy, and the equations of conservation of the individual isotopic species. The equations for the diffusion fluxes of the species include both ordinary and thermal diffusions. These coupled equations are solved by a finite-difference method using upwind schemes and variable mesh. The results demonstrate the influence of the concentration- and temperature-induced surface tension gradients in creating the uniform liquid fuel layer inside an ICF target. Comparison of the present theory with the experimental data is made for targets filled, respectively, with D_2 and mixtures of H_2 and D_2, producing good agreement in both cases.

36167 X-ray microscopy of inertial fusion targets using a laser-produced plasma as an x-ray source. Kim, H.; Wittman, M.D. (Laboratory for Laser Energetics, University of Rochester, Rochester, New York 14623-1299). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2781-2784(Jul 1987).

With the advent of an ablation layer coating technology for mechanically nonsupported inertial fusion targets, the conventional optical interferometric technique for the characterization of these targets is no longer feasible since the batch process of this bounce coating technique makes it difficult to account for individual targets. A soft x-ray contact microradiography method, which was developed for this purpose, is limited in resolution by the 0.5-μm grain size of the photographic medium used. Utilization of an x-ray sensitive photoresist extends the resolution to as low as 50 A. The use of a laser-generated x-ray source for x-ray microscopy appears to require much less energy than published photoresist sensitivity data. A single-shot exposure of 100 J, 0.527-μm wavelength, and 1-ns laser shot suffices for image formation. The resulting x-ray micrographs show a higher spatial resolution than the images obtained by previous radiography techniques. The resolution of 0.2 μm in the present study is due to the finite size of the x-ray source.

36168 Plasma-surface interactions: The role of charged particle emission. Hofer, W.O. (Projekt Kernfusion, KFA-Juelich D-5170 Juelich, West Germany and Solid State Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2213-2216(Jul 1987). Contract AC05-84OR21400.

It is pointed out that several of the main erosion processes in plasma-surface interactions are governed by electron emission from the solids' surfaces.

36169 Effects of radio frequency waves on the sputtering of ion cyclotron resonance heating antenna Faraday shields. Caughman, J.B.O. II; Ruzic, D.N.; Hoffman, D.J. (Department of Nuclear Engineering, University of Illinois, Urbana, Illinois 61801). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **5**: No. 4, 2301-2304(Jul 1987).

The sputtering of the graphite covered Faraday shield of an ion cyclotron resonance heating loop antenna has been studied. The antenna operated at 50 MHz and was exposed to a weakly magnetized plasma produced by the High Particle Flux Facility at Oak Ridge National Laboratory. The flux at the antenna was on the order of 3 x 10^{17} cm^{-2} s^{-1}. A dc bias voltage applied to the antenna allowed the effective energy of the impinging hydrogen ions to be varied up to 65 eV. Coupled rf power varied from 0 to 3 kW. Sputtering depths were directly measured by surface topography. Sputtering enhancement due to rf was between a factor of 2 to 4, depending on the position along the antenna. Antenna voltage profiles

were calculated and used to correlate measured erosion coefficients with ion energies. Various sputtering theories and possible chemical sputtering effects are discussed.

36170 **Simultaneous gas- and plasma-driven hydrogen transport in solids.** Brice, D.K.; Doyle, B.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2311-2314(Jul 1987). Contract AC04-76DP00789.

The transport parameter formalism for evaluating the steady-state hydrogen (tritium) inventory, permeation rate, and recycle time for surfaces exposed to the plasma of an operating magnetic confinement fusion reactor has been extended to include synergistic effects of gas- and plasma-driven permeation. This steady-state formalism includes hydrogen trapping, recombination barriers to release at inner and outer surfaces, diffusion, and effects of thermal gradients (e.g., Ludwig—Soret effect) and is applicable to simultaneous plasma-driven and gas-driven hydrogen injection. In addition to providing a simple way of calculating the magnitude of these important tritium-related concerns, the transport parameter together with the ratio of the recombination coefficients at the two surfaces can also be used to classify the nature of these processes as to whether they are rate limited by bulk diffusion or surface recombination. New simple equations are derived which define these various regimes, and a new regime is identified which could influence permeation-probe measurements of plasma-edge fluxes.

36171 **High-throughput continuous cryopump.** Foster, C.A. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2558-2562(Jul 1987). Contract AC05-84OR21400.

A cryopump with a unique method of regeneration which allows continuous operation at high throughput has been constructed and tested. Deuterium was pumped continuously at a throughput of 30 Torr l/s at a speed of 2000 l/s and a compression ratio of 200. Argon was pumped at a throughput of 60 Torr l/s at a speed of 1275 l/s. To produce continuous operation of the pump, a method of regeneration that does not thermally cycle the pump is employed. A small chamber (the "snail") passes over the pumping surface and removes the frost from it either by mechanical action with a scraper or by local heating. The material removed is topologically in a secondary vacuum system with low conductance into the primary vacuum; thus, the exhaust can be pumped at pressures up to an effective compression ratio determined by the ratio of the pumping speed to the leakage conductance of the snail. The pump, which is all-metal sealed and dry and which regenerates every 60 s, would be an ideal system for pumping tritium. Potential fusion applications are for pump limiters, for repeating pneumatic pellet injection lines, and for the centrifuge pellet injector spin tank, all of which will require pumping tritium at high throughput. Industrial applications requiring ultraclean pumping of corrosive gases at high throughput, such as the reactive ion etch semiconductor process, may also be feasible.

36172 **Characterization of charcoals for helium cryopumping in fusion devices.** Sedgley, D.W.; Tobin, A.G.; Batzer, T.H.; Call, W.R. (Grumman Corporation, Bethpage, New York 11714). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2572-2576(Jul 1987).

The capability of charcoal as a sorbent for helium at cryogenic temperatures depends upon charcoal characteristics that are not well understood. Previous work by the authors has indicated that the charcoals' pumping capability for helium depends as much on their source as on their particle size distributions. To develop a correlation between the physical characteristics of charcoal and helium pumping performance, different charcoals based on wood, coal, coconut, and a petroleum by-product were obtained from commercial sources. They were bonded to an aluminum substrate, and cooled to liquid-helium temperatures in a vacuum chamber. The helium pumping speed at constant throughput versus quantity of helium absorbed was measured for each charcoal grade. Porosimetry measurements on each charcoal grade using nitrogen as the sorbent gas were made that included total surface area, adsorption and desorption isotherms, and pore area and pore volume distributions. Significant differences in helium pumping performance and in pore size distribution were observed. Comparisons are made between helium pumping performance and charcoal characteristics and a possible correlation is identified.

36173 **Pumping of hydrocarbons using nonevaporable getters.** Emerson, L.C.; Knize, R.J.; Cecchi, J.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2584-2586(Jul 1987).

Pumping speed measurements have been obtained for a number of gaseous hydrocarbons including members of the alkene, alkadiene, and cycloalkane groups as a function of temperature using a Zr—Al alloy getter. Pumping speeds were obtained by analysis of an exponential least-squares fit to the pressure decay curve following introduction of each gas. It was found that these pumping speeds are relatively high (up to 400 l/s) and exhibit, with only a few exceptions, little temperature dependence. This is in contrast to the earlier reported results for the alkane series.

36174 **Sputtering and redeposition behavior of VBe_{12} compound and of Ti—Cu—Li composites within a fusion tokamak environment.** DeWald, A.B. Jr.; Brooks, J.N.; Krauss, A.R.; Gruen, D.M. (Georgia Institute of Technology, Atlanta, Georgia 30332). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2763-2767(Jul 1987).

VBe_{12} compound and porous titanium composites infiltrated with a lithium bearing copper alloy have been investigated as a means of reducing fusion plasma impurities and sputter erosion associated with fusion tokamak limiter and divertor surfaces. These materials possess high-temperature strength and melt-layer stability properties in conjunction with the self-sustainment of a low-Z overlayer that inhibits erosion of the underlying structural substrate. The sputter erosion and redeposition properties of these materials have been analyzed by calculating the sputtering coefficients via TRIM, which are subsequently used in the REDEP code to evaluate their performance for various plasma-edge temperature regimes. The results have been compared to elemental beryllium, tungsten, and graphite on the basis of minimizing plasma impurities and material erosion, suppressing runaway self-sputtering, and/or enhancing thermal properties.

36175 **Pumping of hydrogen during plasma—graphite interaction.** Hsu, W.L.; Causey, R.A. (Sandia National Laboratories, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* 5: No. 4, 2768-2772(Jul 1987). Contract AC04-76DP00789.

In a vacuum vessel filled with hydrogen gas and valved off from vacuum pumps, large amounts of hydrogen were removed when a discharge was struck with graphite material cathodes within the vessel. The pumping phenomenon persisted indefinitely and at a constant rate. The amount of hydrogen consumed considerably exceeded the expected hydrogen retention in graphite but can be accounted for, to within a factor of 2, in the hydrogen-rich carbon layers deposited on the surrounding vacuum vessel. This co-deposited hydrogen was at least 30 times the amount retained in the graphite electrodes.

36176 **Helical axis stellarator with noninterlocking planar coils.** Reiman, A.; Boozer, A.H. (to Dept. of Energy, Washington, DC). US Patent 4,663,109. 5 May 1987. Filed date 6 Mar 1984. vp.

A closed, curved, planar toroidal field coil is described for use on a stellarator having a helical axis, the coil having a radius r/ sub o/, pitch kr/sub o/ and period m, the curve of the coil being defined in rho, θ coordinates. A relationship is given.

36177 **System for and method of producing and retaining tritium.** Kim, J.H.; Loewenstein, W.B. (to Electric Power Research Institute, Inc., Palo Alto, CA). US Patent 4,663,111. 5 May 1987. Filed date 21 Oct 1985. vp.

An arrangement is described for producing tritium and retaining substantially all of the tritium so produced within the envi-

ronment of a fast breeder reactor which provides a supply of neutron radiation during operation. The arrangement comprises: means forming part of the fast breeder reactor for producing neutron radiation; a housing which is pervious to the neutron radiation at least to a limited extent and substantially impervious to tritium; a volume of lithium bismuth material contained within the housing and thereby subjected to the neutron radiation during the production, whereby to produce tritium; and a sufficiently large volume of nickel material contained within the housing and disposed sufficiently close to the lithium bismuth so as to retain substantially all of the tritium produced by the lithium bismuth.

99 GENERAL AND MISCELLANEOUS

9901 Management

36178 (DOE/IG—0240) Management and operating contractors' pension plans. (USDOE Office of Inspector General, Albuquerque, NM. Western Regional Office). 1 Jun 1987. 32p. OSTI, PO Bx 62, Oak Ridge, TN 37831. File Number TI87011109.

Report to The Secretary.

This report concerns the management of 28 M & O contractor pension plans with assets exceeding $2.6 billion in 1983. At the end of 1983, these pension plans were overfunded by $600 million. The Department could have saved $94 million in 1983 had the contractors been required to limit their pension plan contributions to the Government-established minimum level. Since 1979, the Department has continually reimbursed these contractors for contributions to pension plans that were already overfunded and we estimate that these plans are currently overfunded in excess of $1 billion. Additional annual savings of about $548,000 could be realized if the Department obtained waivers for M & O contractors participating in the Pension Benefit Guaranty Corporation's (PBGC) insurance program. Management and Administration, which has overall responsibility for controlling such costs, indicated it did not agree that contractors should fund pension plans at only the minimum required level. General agreement was indicated with the need to obtain waivers from PBGC premiums and better protect the Department's interest in contractor excess pension assets.

36179 (RFP—4117) Organizational structure and management theory: The team concept. Sakaguchi, R.W. (Colorado State Univ., Fort Collins (USA). Dept. of Mechanical Engineering). 1987. Contract AC04-76DP03533. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87011055.

This thesis discusses the use of the team concept in a large, diverse company. The study was done at Rockwell International, North American Space Operations, Rocky Flats Plant. The team concept is a parameter to productivity in many successful companies. The associated variables considered in this study of organizational dynamics in the application of the team concept were organizational structure, boundaries and boundary spanning, communications, management style and managers, and motivational factors. The overall results were very successful. The group set a new standard of performance for the plant. The flow of accurate information and communication was very effective in improving productivity. The roles the managers assumed were also significant in improving productivity.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 34877, 35370, 35542, 35683

36180 (AD-A—178169/9/XAB) Nonlinear real-time optical signal processing. Annual technical report, 1 July 1985-30 June 1986. Sawchuk, A.A.; Jenkins, B.K. (University of Southern California, Los Angeles (USA). Signal and Image Processing Inst.). 18 Sep 1986. 33p. NTIS, PC A03/MF A01.

During the period 1 July 1985 - 30 June 1986, the research under Grant AFOSR-84-0181 has concentrated on various aspects of optical digital computing. Detailed studies of a sequential optical parallel-computing architecture, whose wiring is implemented by computer-generated holograms were continued. Implementation of various specialized processors such as cellular logic processors on this architecture was studied, and high-space-bandwidth-interconnection holograms that serve this purpose were examined. The implementation of some architectures such as cellular hypercubes and pyramids are not feasible for electronic VLSI, but are more easily suited to the page-oriented architecture of a 2-D digital optical array. Mathematical morphology was examined as a basic image algebra for cellular logic image processing, and three fundamental image operations were found: complement; union (or intersection); dilation (or erosion) are sufficient to implement any binary morphological function. A final area of study was investigation of abstract parallel computing models in the context of the physical constraints and technology of optical computing. These models include shared memory and graph/network models.

36181 (AD-A—178286/1/XAB) Communication-efficient parallel graph algorithms. Technical report. Leiserson, C.E.; Maggs, B.M. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Dec 1986. 28p. (MIT/LCS/TM—318). NTIS, PC A03/MF A01.

Communication bandwidth is a resource ignored by most parallel random-access machine (PRAM) models. This paper shows that many graph problems can be solved in parallel, not only with polylogarithmic performance, but with efficient communication at each step of the computation. We measure the communication requirements of an algorithm in a model called the distributed random-access machine (DRAM), in which communication cost is measured in terms of the congestion of memory accesses across cuts of an underlying network. The algorithms are based on a communication-efficient variant of the tree contraction technique due to Miller and Reif.

36182 (AD-A—178287/9/XAB) Efficient parallel algorithms for (5+1)-coloring and maximal independent set problems. Goldberg, A.V.; Plotkin, S.A. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Jan 1987. 28p. (MIT/LCS/TM—320). NTIS, PC A03/MF A01.

An efficient technique for breaking symmetry in parallel is described. The technique works especially well on rooted trees and on graphs with a small maximum degree. In particular, a maximal independent set can be found on a constant-degree graph in O(lg*n) time on an EREW PRAM using a linear number of processors. It is shown how to apply this technique to construct more efficient parallel algorithms for several problems, including coloring of planar graphs and (delta + 1)-coloring of constant-degree graphs. Lower bounds for two related problems are proved.

36183 (AD-A—178370/3/XAB) Early parallel processing in reading: a connectionist approach. Technical report, April-November 1986. Mozer, M.C. (California Univ., San Diego, La Jolla (USA). Inst. for Cognitive Science). Dec 1986. 33p. (ICS—8611). NTIS, PC A03/MF A01.

To what extent can information distributed across the visual field be processed in parallel. A connectionist model capable of recognizing multiple words appearing simultaneously on its retina is described that addresses this question. The model relies on the notion of a hierarchy of detectors, starting at the lowest level with position-specific primitive-feature detectors, and progressing to a level composed of position-independent letter cluster detectors. Intervening levels register successively higher-order features and also collapse over local spatial regions of the level below resulting in less positional specificity of the detectors. Using an associative learning rule, the model has been taught to recognize a large sample of words in arbitrary retinal locations. Following this training, it is also able to recognize several words simultaneously, although under certain conditions crosstalk among words can become unmanageable. The model includes an attentional mechanism, which can limit crosstalk, and a serial readout mechanism, which is necessary for a word to reach awareness. While exhaustive simulation experiments have yet to be carried out, there are a variety of phenomena, both experimental and anecdotal, that the model appears well-equipped to account for, including: translation and scale invariant recognition, positional uncertainty at the letter and word levels, the recognition of misspelled words, the integra-

tion of information across fixations, similarity-based interference effects, and the role of focal attention in localization.

36184 (AD-A—178403/2/XAB) Efficient graph algorithms for sequential and parallel computers. Doctoral thesis. Goldberg, A.V. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Computer Science). Feb 1987. 126p. (MIT/LCS/TR—374). NTIS, PC A07/MF A01.

This thesis studies graph algorithms, both in sequential and parallel contexts. In the outline of the thesis, algorithm complexities are stated in terms of the the number of vertices n, the number of edges m, the largest absolute value of capacities U, and the largest absolute value of costs C. Chapter 1 introduces a new approach to the maximum flow problem that leads to better algorithms for the problem. Chapter 2 is devoted to the minimum cost flow problem, which is a generalization of the maximum flow problem. Chapter 3 addresses implementation of parallel algorithms through a case study of an implementation of a parallel maximum flow algorithm. Parallel prefix operations play an important role in the implementation. Present experimental results achieved by the implementation are presented. Present parallel symmetry-breaking techniques are the main topic of Chapter 4.

36185 (AD-A—178564/1/XAB) JCL (job control language) procedures to run the HULL code on the Cyber 205 computer installed on CSIRONET. Technical note. Smith, D.L. (Materials Research Labs., Ascot Vale (Australia)). Nov 1986. 23p. (MRL-TN—508). NTIS, PC A02/MF A01.

The HULL code is a suite of programs for solving problems of hydrodynamic flow. HULL is a self contained system, with internal maintenance and editing facilities, currently capable of running on a number of computer sited through the world. A utility for the HULL system called SAIL manages the internally coded system, and is used to generate Fortran programs appropriate to the problem being solved. The Materials Research Laboratories obtained a current version of the HULL system early in 1986 from Eglin AFB, through TTCP channels. This version (HULL 120) is capable of solving problems in two or three dimensions, using Eulerian or Lagrangian equations of motion, or a combination of both. Hull 120 has models for elastic/plastic material behaviour, and explosive burn routines, HULL 120 is currently being installed and tested on a Control Data Cyber 205 supercomputer on the CSIRONET network. Part of the installation involves embedding into the HUll system the necessary parameters and changes to make HULL-generated code run correctly on the 205. This process is not yet complete, and will be reported separately. A second part of the installation involves writing the job control language to run HULL. This report describes a complex set of JCL procedures developed at MRL to run HULL programs on the CSIRONET Cyber 205.

36186 (AD-A—178816/5/XAB) Parallel branch and bound on an MIMD (multiple instruction stream, multiple data stream) system. Technical report. Trienekens, H.W. (Colorado Univ., Boulder (USA). Dept. of Computer Science). 16 Feb 1987. 29p. (CU-CS—360-87). NTIS, PC A03/MF A01.

This paper gives a classification of parallel branch and bound algorithms and develops a class of asynchronous branch and bound algorithms for execution on an MIMD system. Sufficient conditions were developed to prevent the anomalies that can occur due to the parallelism, the asynchronicity or the nondeterminisim, from degrading the performance of the algorithm. Such conditions were known already for the synchronous case. It turns out that these conditions are sufficient for asynchronous alogrithms as well. Consequences of nonhomogeneous processing elements in a parallel computer system were also investigated. Notions of perfect parallel time were introduced and efficiency was achieved to empirically measure the effects of parallelism, because the traditional notions of speedup and efficiency are not capable of fully characterizing the actual execution of an asynchronous parallel algorithm. Finally, some computational results obtained for the symmetric traveling-salesman problem are presented.

36187 (AD-A—178956/9/XAB) Connected-component labeling in image processing with MIMD (multiple instruction, multiple data) architectures. Technical report. Hummel, R.A.; Rojer, A. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Jul 1985. 26p. (TR—173). NTIS, PC A03/MF A01.

Also available as Rept. no. ULTRACOMPUTER NOTE-87.

Many higher-level image-processing algorithms suggest dynamic allocation of multiple processors to image-processing subtasks. However, most parallel algorithms in image processing assume an SIMD (Single Instruction Multiple Data) architecture with processors statically assigned to one or a group of image pixels. For many vision tasks, fixed assignments of processors will inevitably lead to low parallelism. Instead, it seems natural to have an intermediate number of more-powerful independent processors, each with access to the shared data, to perform tasks that tend to be more global in nature. In converting SIMD algorithms into efficient code for MIMD (Multiple Instruction Multiple Data) machines with relatively fewer processors, it can frequently be determined when processors are active and when they are dormant. By analyzing the dynamic flow of subtasks, we can attempt to assign processors to the portions of the image where non-null tasks would be accomplished in a more processor-rich environment. The authors study, as an example, the Shiloach/Vishkin connected component algorithm, which is an O(logN) SIMD algorithm which requires roughly 4N processors, where N is the number of pixels.

36188 (ANL/MCS-TM—91) Parallel computation of a domain decomposition method. Chin, R.C.Y.; Hedstrom, G.W.; Scroggs, J.S.; Sorensen, D.C. (Argonne National Lab., IL (USA). Mathematics and Computer Science Div.). Apr 1987. Contract W-31109-ENG-38;W-7405-ENG-48;AC05-84OR21400;FG02-85ER25001. 17p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87004344.

We present a parallel algorithm for the efficient solution of a singularly perturbed parabolic partial differential equation. The method is based upon domain decomposition that is dictated by singular perturbation analysis. A transformation is made to a coordinate system induced by the characteristics of the reduced hyperbolic equation. Asymptotic analysis is used to determine regions where certain reduced equations may be solved in place of the full equation. This reduces the number and size of the domains where the full equation must be solved. Parallelism is evident at two levels. Domain decomposition provides parallelism at the highest level, and within each domain there is ample opportunity to exploit additional parallelism. Important features of the method include independent solution of the characteristic curves at the lowest level and low communication requirements between processes devoted to solving in the various domains. Tightly coupled processes are only required in domains where the full equation must be solved. We discuss the implementation and some aspects of the performance of this algorithm on existing parallel computers. We also touch upon certain aspects of iterative solution of nonlinear problems.

36189 (BDX—613-3762) Data modeling projects at Bendix Kansas City. Hobbs, D.L. (Allied Corp., Kansas City, MO (USA). Bendix Kansas City Div.). May 1987. Contract AC04-76DP00613. 14p. (CONF-8704126—3). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009392.

From VIM conference; Ottawa, Canada (27 Apr 1987).

This paper presents a discussion of three data modeling projects in an attempt to share the author's experiences with the NIAM data modeling methodology and some of his observations and opinions about it. The three projects are all different in their use of NIAM and in their size. One is a small proto-type project, one is a medium-large information system, and one is a plant-wide information system project.

36190 **(CONF-870290—1) Selected examples of practical approaches for the assessment of model reliability - parameter uncertainty analysis.** Hofer, E.; Hoffman, F.O. (Oak Ridge National Lab., TN (USA); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Feb 1987. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87009668.

From OECD/NEA workshop on uncertainty analysis for systems performance assessments; Seattle, WA, USA (24 Feb 1987).

The uncertainty analysis of model predictions has to discriminate between two fundamentally different types of uncertainty. The presence of stochastic variability (Type 1 uncertainty) necessitates the use of a probabilistic model instead of the much simpler deterministic one. Lack of knowledge (Type 2 uncertainty), however, applies to deterministic as well as to probabilistic model predictions and often dominates over uncertainties of Type 1. The term "probability" is interpreted differently in the probabilistic analysis of either type of uncertainty. After these discriminations have been explained the discussion centers on the propagation of parameter uncertainties through the model, the derivation of quantitative uncertainty statements for model predictions and the presentation and interpretation of the results of a Type 2 uncertainty analysis. Various alternative approaches are compared for a very simple deterministic model.

36191 **(CONF-870822—1) Application of AI [Artificial Intelligence] to management and analysis problems.** DeLozier, R.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87011120.

From American Institute of Chemical Engineers summer national meeting; Minneapolis, MN, USA (16 Aug 1987).

This paper concerns the on-going development of the Naval Aviation Integrated Logistic (NAIL) package and the applications of Artificial Intelligence (AI) techniques using the PROLOG language. This package is being developed at the Oak Ridge National Laboratory (ORNL) for the Naval Aviation Logistic Center (NALC) to aid in projecting equipment repair and replacement requirements under assumed scenarios. Although NAIL is being designed for Naval applications, it can be used in virtually any large-scale operating environment, e.g., chemical manufacturing processes.

36192 **(CONF-8406359—1) The maximal chain model: A one dimensional system with a first-order phase transition.** Van der Hoek, J.; Zweifel, P.F. (Florence Univ. (Italy). Ist. Matematico). 1985. Contract AS05-80ER10711. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010674.

From Sitges conference on statistical mechanics; Sitges, Spain (10 Jun 1984).

A one-dimensional model is described for a system interacting through forces of finite range. Using the model the thermodynamics can be computered explicitly by completely elementary means, and the model gives use to a first-order phase transition. (WRF)

36193 **(CONF-8703131—1) Parallel computing on a hypercube: An overview of the architecture and some applications.** Ostrouchov, G. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02. File Number DE87010020.

From 19. symposium on the interface of computer science and statistics; Philadelphia, PA, USA (8 Mar 1987).

A hypercube parallel computer is a network of processors, each with only local memory, whose activities are coordinated by messages the processors send between themselves. The interconnection network corresponds to the edges of an n-dimensional cube with a processor at each vertex. This paper gives an overview of the hypercube architecture and its relation to other distributed-memory message-passing multiprocessors. The computation of a crossproducts matrix is an important part of many applications in statistics and provides a simple yet interesting example of a hypercube algorithm. This example is presented to illustrate the concepts in programming of a hypercube.

36194 **(DOE/ER/13069—4) Topics in large sparse nonlinear optimization: Final report, May 1, 1983-April 30, 1986.** Coleman, T.F. (Cornell Univ., Ithaca, NY (USA). Dept. of Computer Science). Feb 1987. Contract AC02-83ER13069. 3p. NTIS, PC A02/MF A01; GPO Dep. File Number DE87010660.

We have achieved some success, under this contract, in developing useful algorithms, algorithmic tools, and software for large sparse nonlinear optimization.

36195 **(DOE/ER/25026—5) On obtaining a consistent set of initial values for a system of differential-algebraic equations.** Leimkuhler, B.J.; Petzold, L.R.; Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). May 1987. Contract FG02-87ER25026. 44p. (UILU-ENG—87-1732; UIUCDCS-R—87-1344). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010572.

Discussed are some of the difficulties in designing a general algorithm for determining a consistent initial vector for a DAE when only part of the vector is known. A set of relations (the consistency equations) are derived which an initial vector should satisfy in order for there to be a smooth solution through the point which is also consistent with known initial data. An approximation to one of the individual derivative equations was constructed, and the solution of the resulting system of approximated consistency equations was considered. In particular, it was noted that the system does not admit an exact solution so that some sort of least-squares approximation is called for. Finally, some preliminary numerical experiments were described. These experiments tend to validate some of the concepts discussed in this report, although they are too limited in scope to suggest anything meaningful about the applicability of this work. Two critical obstacles prevent the implementation of these ideas: a method must be found to efficiently solve (in the least-squares sense) a large system of overdetermined nonlinear equations with a sparse, rank-deficient Jacobian, and there is the need for an error estimation and control mechanism which can adjust various parameters to meet a required accuracy.

36196 **(DOE/ER/25026—7) Implementation of s-step methods on parallel vector architectures.** Chronopoulos, A.T.; Gear, C.W. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Jun 1987. Contract FG02-87ER25026. 27p. (UILU-ENG—87-1734; UIUCDCS-R—87-1346). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010820.

Efficient implementation of the s-step Conjugate Gradient method on vector and parallel machines is discussed. The two different architecture models considered are the shared memory machines with memory hierarchy and the message passing private memory machines. For a parametrized vector architecture similar to CRAY-1 or CRAY-2 we show that s-CG used to solve an elliptic partial differential equation problem is twice as fast as CG. For the message passing parallel architectures (Hypercube) a speedup of 2s over CG can be achieved.

36197 **(DOE/OR/00033—T298) Electric probe data analysis for glow discharge diagnostics.** Cain, B.L. (Illinois Univ., Urbana (USA)). Jan 1987. Contract AC05-76OR00033. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. File Number DE87009211.

This report summarizes the development and application of digital computations for the analysis of data from an electric probe used for glow discharge diagnostics. The essential physics of the probe/discharge interaction is presented, along with formulations from modern electric probe theory. These results are then digitally implemented by a set of computer programs which both calculate discharge properties of electron temperature and density, and aid in the interpretation of these property estimates. The method of analysis, and the theories selected for implementation, are valid only for low pressure, collisionless sheath, and quiescent discharges where the single electric probe has a much smaller area than the discharge reference electrode. However, certain algorithms are included which, in some cases, can extend the analysis into intermediate pressure regimes. The digital programs' functional capabilities are demonstrated by the analysis of experimental probe data, collected

using a laboratory glow discharge. Typical sources of error inherent in the electric probe method are discussed, along with an analysis of error induced by the computational methods of the programs. 27 refs., 49 figs., 20 tabs.

36198 **(HEDL-SA—3397) The trials and tribulations of purchasing robots for nuclear applications.** Moore, F.W.; Bowen, W.W. (Hanford Engineering Development Lab., Richland, WA (USA)). 30 Apr 1986. Contract AC06-76FF02170. 8p. (CONF-8511129—5). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010409.

From RAWG robotic and automation workshop; Los Alamos, NM, USA (21 Nov 1985).

The adaptation of commercial robots using current robotic technology to handle and manufacture nuclear materials has had its problems. The robots available today were developed primarily to support the automotive or electronics industries. Nuclear material is very heavy, abrasive material with stringent accountability and nuclear safety requirements. The operational space and maintenance constraints have special consideration where the robotic system must operate and be maintained in an environmentally controlled area. The robotic systems of today tend to have limited payload capability for nuclear applications or, if the payload is sufficient, the system is very large and has several operating and maintenance accessibility requirements. The process of specifying, purchasing, and modifying a robotic system is an expensive and time-consuming process at best. The process of product evaluation, operation envelop, design maintenance concepts, and special nuclear materials handling requirements are essential in the development of a procurement specification. The procurement specification is critical to getting an economical robotic system and successfully enticing robotic vendors to quote for nuclear applications.

36199 **(LA—11016-MS) The Abel integral equation.** Faber, V.; Wing, G.M. (Los Alamos National Lab., NM (USA)). Jun 1987. Contract W-7405-ENG-36. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010840.

Many noninvasive laboratory experiments lead to mathematical models involving the Abel integral equation. We present an example of such an experiment and then describe two classical ways of obtaining the solution to the Abel equation. Numerical implementation of this solution is often unsatisfactory because approximate differentiation of experimental data is required. An alternative approach based on the "singular value decomposition" is outlined and a brief description of a numerical algorithm based on this approach is given. A computer program employing this algorithm is used to solve three test problems. The results are presented graphically.

36200 **(LA-UR—87-1150) Bootstrapped models for intrinsic random functions.** Campbell, K. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 32p. (CONF-8704137—1). NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87008987.

From MGUS '87; Redwood City, CA, USA (13 Apr 1987).

The use of intrinsic random function stochastic models as a basis for estimation in geostatistical work requires the identification of the generalized covariance function of the underlying process, and the fact that this function has to be estimated from the data introduces an additional source of error into predictions based on the model. This paper develops the sample reuse procedure called the "bootstrap" in the context of intrinsic random functions to obtain realistic estimates of these errors. Simulation results support the conclusion that bootstrap distributions of functionals of the process, as well as of their "kriging variance," provide a reasonable picture of the variability introduced by imperfect estimation of the generalized covariance function.

36201 **(LA-UR—87-1541) An implementation of the new IEEE standard routines for FASTBUS.** Kolowski, T.; Foreman, W.M. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-870552—14). NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87010107.

From 5. conference on real-time computer applications in nuclear particle and plasma physics; San Francisco, CA, USA (11 May 1987).

We have implemented a subset of the new 1987 IEEE standard routines for FASTBUS for the General Purpose Master (GPM), a FASTBUS master developed at CERN. Experiences in implementing and using the new standard routines for FASTBUS are reported.

36202 **(RISO-M—2607) DYSIM - a modular simulation system for continuous dynamic processes.** la Cour Christensen, P.; Kofoed, J.E.; Larsen, N. (Risoe National Lab., Roskilde (Denmark)). Sep 1986. 72p. NTIS (US Sales Only), PC A04/MF A01. File Number DE87752181.

The report describes a revised version of a simulation system for continuous processes, DYSIM. In relation to the previous version, which was developed in 1981, the main changes are conversion to FORTRAN 77 and introduction of modular structure. The latter feature gives the user a possibility for decomposing the model in modules corresponding to well delimited ph ysical units, a feature which gives a better survey of the model. Furthermore, two new integration routines are included in addition to the single one used before.

36203 **(SAND—87-0679) UPEML Version 2.0: A machine-portable CDC Update emulator.** Mehlhorn, T.A.; Young, M.F. (Sandia National Labs., Albuquerque, NM (USA)). May 1987. Contract AC04-76DP00789. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010994.

UPEML is a machine-portable CDC Update emulation program. UPEML is written in ANSI standard Fortran-77 and is relatively simple and compact. It is capable of emulating a significant subset of the standard CDC Update functions, including program library creation and subsequent modification. Machine-portability is an essential attribute of UPEML. UPEML was written primarily to facilitate the use of CDC-based scientific packages on alternate computer systems such as the VAX 11/780 and the IBM 3081. UPEML has also been successfully used on the multiprocessor ELXSI, on CRAYs under both COS and CTSS operating systems, on APOLLO workstations, and on the HP-9000. Version 2.0 includes enhanced error checking, full ASCI character support, a program library audit capability, and a partial update option in which only selected or modified decks are written to the compile file. Further enhancements include checks for overlapping corrections, processing of nested calls to common decks, and reads and addfiles from alternate input files.

36204 **(SOL—87-5) Origins of the simplex method.** Dantzig, G.B. (Stanford Univ., CA (USA). Systems Optimization Lab.). May 1987. Contract FG03-87ER25028. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. File Number DE87011027.

Today we know that before 1947 that four isolated papers had been published on special cases of the linear programming problem by Fourier (1824), de la Vallee Poussin (1911), Kantorovich (1939) and Hitchcock (1941). All except Kantorovich's paper proposed as a solution method descent along the outside edges of the polyhedral set which is the way we describe the simplex method today. There is no evidence that these papers had any influence on each other. Evidently they sparked zero interest on the part of other mathematicians and were unknown to me when I first proposed the simplex method. As we shall see the simplex algorithm evolved from a very different geometry, one in which it appeared to be very efficient.

36205 **(UCID—20950) Control system research for directed energy weapons: FY86 annual technical report.** Young, K.D. (ed.). (Lawrence Livermore National Lab., CA (USA)). Oct 1986. Contract W-7405-ENG-48. 539p. NTIS, PC A23. File Number DE87005206.

This report describes program progress in numerical algorithms for controls and robust control methods. Nine papers have been separately indexed. Additional information is presented in the report on the following topics: large scale systems control methods; multirate digital control; decentralized/regulated control methods; and mathematical modeling for flexible structures.

36206 (UCID—20950, pp 19-63) **Improving the efficiency of matrix operations in the numerical solution of large implicit systems of linear differential equations.** Choi, Chiu H.; Laub, A.J. (Univ. of California, Santa Barbara). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

By combining techniques from numerical linear algebra and well-developed and effective software for ordinary differential equations, a package of efficient procedures is implemented to compute the numerical solution of large implicit systems of (stiff) linear differential equations. Such systems arise naturally in, for example, closed-loop simulations of state space models derived from finite element models. Numerical experiments have been run to evaluate the performance of the package with respect to accuracy and efficiency.

36207 (UCID—20950, pp 65-89) **Decentralized structures for parallel Kalman filtering.** Hashemipour, H.R.; Roy, S.; Laub, A.J. (Univ. of California, Santa Barbara). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

This paper describes various multi-sensor network scenarios whose signal processing tasks are amenable to multi-processor implementation. The natural origins of such multi-tasking are emphasized and new parallel structures for state estimation using the Kalman filter are proposed that extend existing results in several directions. In particular, hierarchical network structures are developed which have the property that the optimal global estimate based on all the available information can be reconstructed from estimates compared by local processor nodes based solely on their own local information and transmitted to a central processor. The algorithms yield an approximately linear speed-up rate, are reasonably failure-resistant, and are optimized with respect to communication bandwidth and memory requirements at the various processors.

36208 (UCID—20950, pp 92-104) **Processor arrays for polynomial interpolation.** Koc, C.K.; Gallopoulos, E. (Univ. of California, Santa Barbara). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

This paper introduces array architectures for polynomial interpolation. Three types of polynomial interpolation are considered: the Lagrange interpolation and Newton interpolation methods which require information about the values of the function and the general Hermite interpolation which also requires information about the derivatives. The Aitken and the Neville recursive schemes are considered for the three types of interpolation. Array architectures implementing these algorithms are given and compared. The algorithms are suitable for parallel-pipelined implementation on self-timed asynchronous processor arrays.

36209 (UCID—20950, pp 105-117) **Fast and practical, parallel polynomial interpolation.** Gallopoulos, E.; Koc, C.K. (Univ. of California, Santa Barbara). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

This paper presents fast and practical parallel algorithms for the computation and/or evaluation of interpolating polynomials. By fast it is meant that the algorithms require time less than $2\lceil\log(n+1)\rceil + 2$ and circuit size $O(n^2)$. By practical it is meant that the algorithms may be implemented in floating-point with resulting error accumulation similar to the one for the stable and widely used serial algorithms. The advantages of the presented algorithm are the following: The interpolation points don't have to be equidistant. No preconditioning is assumed. No use of the Fast Fourier transform is made. An arithmetic circuit of size $O(n^2)$ may be constructed for the algorithm if needed. The algorithm is numerically stable. The interpolating polynomial is calculated in its Newton form making easy the evaluation of it and its derivatives if so required. Numerical experiments indicate that the error is in practice only slightly worse than the error associated with the stable Neville algorithm and better than the Aitken algorithm. This in contrast to other fast serial and parallel interpolation algorithms, which are subject to much larger roundoff. The algorithm is nicely mapped on a hypercube connected system.

36210 (UCID—20950, pp 118-151) **Error analysis of serial and parallel interpolation algorithms.** Gallopoulos, E.; Koc, C.K. (Univ. of California, Santa Barbara). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

An error analysis is presented for serial and parallel interpolation algorithms. New results are proved for the numerical behavior of the fast interpolation algorithms presented in the context of computational complexity research. Expressions and bounds for the absolute errors in the calculation of the divided difference coefficients for Newton interpolation by means of the Neville and Aitken algorithms are computed. The corresponding expressions and bounds for a family of new parallel Newton interpolation algorithms are computed and compared. It is shown both analytically and numerically that the new algorithm is stable and has a behavior similar to the stable serial algorithms and that all these algorithms are better than other fast parallel algorithms. The condition number of the Newton polynomial representation in the interval [-1,1] is calculated. We claim that as long as Newton interpolation is under consideration, our algorithm is superior to all other parallel interpolation algorithms.

36211 (UCID—20950, pp 274-294) **"Toeplitz + Hankel" structures in H/sub ∞/ design and fast algorithms for evaluating the achievable performance.** Jonckheere, E.A.; Juang, Jyh-Ching. (Univ. of Southern California, Los Angeles). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

The development of fast algorithms for H/sub ∞/ design computations using "Toeplitz + Hankel operators is described. This new algorithm reportedly speeds up design computations by at least a factor of ten. Tests have been conducted on an experimental flexible structure model. (FI)

36212 (UCID—20950, pp 295-316) **A spectral characterization of H/sup ∞/-optimal feedback performance and its efficient computation.** Jonckheere, E.; Verma, M. (Univ. of Southern California, Los Angeles). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

The spectral properties of a "Toeplitz + Hankel" operator which arises in the context of the mixed-sensitivity H/sup ∞/-optimization problem and whose largest eigenvalue characterizes the optimal achievable performance ϵ_0 are presented. The existence of such an operator was first shown by Verma and Jonckheere who also noted the potential numerical advantage of computing ϵ_0 through its eigenvalue characterization rather than through the ϵ-iteration. This operator is investigated in detail, with the objective of efficiently computing its spectrum. An "adjoint" linear-quadratic problem that involves the same "Toeplitz + Hankel" operator is defined. Consequently, a finite polynomial algorithm allows ϵ_0 to be characterized as simply as the largest root of a polynomial and a computationally more attractive state space algorithm emerged from the H/sup ∞//LQ relationship. This algorithm yielded a very good accuracy evaluation of the performance ϵ_0 by solving just one algebraic Riccati equation. Thorough exploitation of this algorithm resulted in a drastic computation reduction with respect to the standard ϵ-iteration.

36213 (UCID—20950, pp 327-359) **H-infinity design of the TRW flexible structure.** Juang, Jyh-Ching; Jonckheere, E.A. (Univ. of Southern California, Los Angeles). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

A plant becomes rank-deficient when we introduce extra sensors to measure its output signals or extra actuators to drive the system. Algorithms of controller design for full-rank plants may not be directly applicable to such plants. In this paper, the properties of rank-deficient plants are analyzed. A structured weighting strategy

is proposed to account for the weird characteristics of different channels of rank-deficient plants. Based upon this strategy, an H/ sub ∞/ controller for a rank-deficient large space TRW structure is designed.

36214 (UCID—20950, pp 368-373) **The LINF computer program for L/sup ∞/ controller design.** Chiang, R.Y.; Safonov, M.G. (Univ. of Southern California, Los Angeles). Oct 1986. NTIS, PC A23. File Number DE87005206.

In Control system research for directed energy weapons: FY86 annual technical report.

A description is provided of the computer program LINF developed for solving L/sup ∞/ optimal control problems. A program flow chart and a brief description of the macros are provided along with an explanation of how to use LINF. (FI)

36215 (UCID—20955) **RED2TEX: A TRIX RED to LATEX converter.** Chase, L.; Langdon, A.B. (Lawrence Livermore National Lab., CA (USA)). 20 May 1987. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. File Number DE87010847.

A summary of RED2TEX is presented. RED2TEX converts standard TRIX RED format commands to TEX or LATEX commands for subsequent LATEX formatting. LATEX is a special version of the TEX document preparation system. LATEX adds to TEX a collection of commands that simplifies formatting. LATEX runs on the J-Vax and the LLL-LCC Pyramid machines. RED2TEX resides in Unix directory CHASE/TEX.

36216 (UCRL—96615) **Some new results using quadratic finite elements for pure advection.** Rowley, J.E.; Gresho, P.M. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 13p. (CONF-870677—6). NTIS, PC A02/MF A01; GPO Dep. File Number DE87009849.

From 6. IMACS international symposium on computer methods for partial differential equations; Bethlehem, PA, USA (23 Jun 1987).

Presented is a study of the one-dimensional (1D) advection equation. The authors present results in three areas. First, analytic solutions are given to the difference equations generated by the application of the Galerkin finite element method (GFEM) with piecewise linear basis functions (LFEM) (which solution has the same form as that for a space-centered second-order finite difference method), and piecewise quadratic (QFEM) basis functions for periodic boundary conditions and a uniform mesh. Second, based on these first results, a resolution is given to the question of the existence of the so-called "backward traveling spurious mode" in the case of QFEM. Third, the numerical behavior is examined for various solution methods on a randomly non-uniform mesh.

36217 **Stereoscopic optical viewing system.** Tallman, C.S. (to Dept. of Energy, Washington, DC). US Patent 4,663,511. 5 May 1987. Filed date 2 May 1986. vp.

This patent describes a pair of independently controlled stereoscopic optical viewing assemblies, each of the pair of assemblies comprising: a prism means to receive an optical range of the workpiece from a first deduction and to reflect the image so that the image now propagates in a vision path along a second direction that is rotated by substantially 90° relative to the first direction; means positioned in the vision path to receive, magnify by a controllable amount, focus and invert the image; and means for viewing the image.

36218 **The implementation and optimization of Portable Standard Lisp for the Cray.** Anderson, J.W.; Kessler, R.R.; Galway, W.F. (C-10, Computer User Services, Los Alamos National Lab., Los Alamos, NM 87545). pp 3-13 of Proceedings of the twentieth Hawaii international conference on system sciences. Shriver, B.D. Honolulu, HI 96743; Hawaii Int'l Conference on System Sciences (1987). (CONF-870108—).

From 20. annual Hawaii international conference on system sciences; Honolulu, HI, USA (6 Jan 1987).

Portable Standard Lisp (PSL), a dialect of Lisp, has been implemented and optimized for the CRAY-1 and CRAY X-MP supercomputers. This version uses a new implementation technique that permits a step-by-step development of the PSL kernel. The Cray version is characterized as the most portable of the PSL implementations because many previously system-dependent modules were redefined in a system independent fashion. Originally, this caused an execution speed penalty; however, Cray-specific optimizations helped to create a fast and reliable Lisp implementation.

36219 **Construction of preconditioners for elliptic problems by substructuring. I.** Bramble, J.H.; Pasciak, J.E.; Schatz, A.H. (Institute of Modern Physics, Academia Sinica, Lanzhou). *Mathematics of Computation;* **47**: No. 175, 103-134(Jul 1986).

We consider the problem of solving the algebraic system of equations which arise from the discretization of symmetric elliptic boundary value problems via finite element methods. A new class of preconditioners for the discrete system is developed based on substructuring (also known as domain decomposition). The resulting preconditioned algorithms are well suited to emerging parallel computing architectures. The proposed methods are applicable to problems on general domains involving differential operators with rather general coefficients. A basic theory for the analysis of the condition number of the preconditioned system (which determines the iterative convergence rate of the algorithm) is given. Techniques for applying the theory and algorithms to problems with irregular geometry are discussed and the results of extensive numerical experiments are reported.

36220 **Modification of the weeks method for numerical inversion of the Laplace transform.** Lyness, J.N.; Giunta, G. (Universita di Napoli, Dipartimento di Matematica & Applicazioni, via Mezzocannone 8, 80134 Napoli, Italy). *Mathematics of Computation;* **47**: No. 175, 313-322(Jul 1986).

The Weeks method for calculating numerical values of f(t) from its Laplace transform F(s) involves the numerical evaluation of a set of contour integrals. In this paper, we describe a powerful modification, by means of which results of comparable accuracy can be obtained using approximately half the number of complex function values. This and other possible minor modifications are discussed.

36221 **Control and simulation of a three jointed finger.** Johnson, V.J.; Loucks, C.S.; Starr, G.P.; Steele, J.P.H. (Sandia National Labs., Albuquerque, NM). pp 267-276 of Recent trends in robotics: Modeling, control and education. Jamshidi, M.; Luh, J.Y.S.; Shahinpoor, M. New York, NY; Elsevier Science Pub. Co. Inc. (1986). (CONF-861155—).

From International symposium on robot manipulators: modeling, control and education; Albuquerque, NM, USA (12 Nov 1986).

Improved dexterity is an area of current research in robotics. At Sandia National Laboratories and the University of New Mexico the authors are pursuing research in this area with the aid of a Stanford/JPL hand from Salisbury Robotics. In this paper they present some of the issues raised in studying the characteristics and control of a single finger of the dexterous hand. The issues they present are dynamic modelling, a friction model and its influence on joint control, and several approaches to controlling the hand including a model-based approach to decouple the joint dynamics and reduce the nonlinear frictional effects. They also discuss the present method for control and mention the direction of future research.

36222 **A testbed for the development of intelligent robot control.** Harrigan, R.W. (Sandia National Labs., Albuquerque, NM). pp 163-168 of Recent trends in robotics: Modeling, control and education. Jamshidi, M.; Luh, J.Y.S.; Shahinpoor, M. New York, NY; Elsevier Science Pub. Co. Inc. (1986). (CONF-861155—). Contract AC04-76DP00789.

From International symposium on robot manipulators: modeling, control and education; Albuquerque, NM, USA (12 Nov 1986).

The Sensor Driven Robot Systems Testbed has been constructed to provide a working environment to aid in the development of intelligent robot control software. The Testbed employs vision and force as the robot's means of interrogating its environ-

ment. The Testbed, which has been operational for approximately 24 months, consists of a PUMA-560 robot manipulator coupled to a 2-dimensional vision system and force and torque sensing wrist. Recent work within the Testbed environment has led to a highly modularized control software concept with emphasis on detection and resolution of error situations.

9903 Information Handling

REFER ALSO TO CITATION(S) 34614, 34847, 34851, 34978, 36186

36223 (EUR—10006, pp 247-285) **Collection, processing and use of data.** Mancini, G. (JRC-Ispra, Italy). 1985. Commission of the European Communities, Ispra, Italy. Joint Research Centre. (CONF-8410459—).

From Pre-launching meeting of the European Safety and Reliability Association (ESRA); Ispra, Italy (9 Oct 1984).

Data are now being collected in many types of activities, such as nuclear reactors and annexed fuel cycle facilities, transport of hazardous materials. The proliferation in the past few years of data banks related to safety and reliability has somewhat alleviated the problem of lack of information when carrying out safety analysis; but it has succeeded meanwhile to identify several crucial aspects in the overall procedures of collection, processing and use of data. These aspects are reviewed in the paper with special emphasis on the interaction of the information and the various interpretative models of component and system behaviour. The need for the analyst of not only validating stated models but also of attempting new interpretations of the facts is particularly stressed. Eventually the role of new Artificial Intelligence techniques in supporting man in his search for model structures - that is the "history" underlying the facts - is mentioned. 12 refs.

36224 (FRA-TM—158) **A 21-group differential nuclear data covariance library based on ENDF/B-V.2.** Liaw, J.R.; Schmidt, R.R. (Argonne National Lab., IL (USA)). Feb 1987. Contract W-31109-ENG-38. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. File Number DE87010174.

The multigroup covariance processing code NJOY/ERRORR module has been used to process 15 major nuclides including actinides, coolant and structural materials common to most LMFBR design studies. Covariance files contained in ENDF/B-V.2 were processed into a 21-group covariance library. These covariance data will be used in estimating uncertainties of various performance and safety parameters of advanced liquid metal reactors currently being investigated at Argonne National Laboratory in order to establish the confidence level of our calculations.

36225 (SAND—87-0215C) **Information network for numeric databases of materials properties.** Allan, F.C. (Sandia National Labs., Albuquerque, NM (USA)). Jun 1987. Contract AC04-76DP00789. 14p. (CONF-8706131—1). NTIS, PC A02. File Number DE87010512.

From 78. annual conference of the Special Libraries Association; Anaheim, CA, USA (6 Jun 1987).

This talk traces the development of a network system for materials properties. It shows what our library has done to be involved. But we have benefitted also. First, there is the sense of being involved in a vital and active process, which has possibilities of developing in various ways. Then there is the feeling that we are contributing to that which we will also be using in the future. In addition, involvement has made us aware of what else has been going on world-wide and the increasing cooperation evolving among all participants. Last, there is the satisfaction from the idea that we are contributing uniquely from our status as a special library.

9905 Civilian Defense

36226 (AD-A—178152/5/XAB) **Civil defense shelters: a state-of-the-art assessment - 1986. Final report.** Chester, C.V.; Zimmerman, G.P. (Oak Ridge National Lab., TN (USA)). Dec 1986. 316p. (ORNL—6252). NTIS, PC A14/MF A01.

The literature on the design, construction, testing, and cost of blast and fallout shelters was reviewed, and a bibliography of over 1000 documents was assembled. It was found that nuclear weapon effects and shelter design are well understood. The principal technical barrier to construction of permanent shelters is cost. Single-purpose blast shelters cost in the high hundreds to low thousands of dollars per space, depending on size, hardness, location, and whether the shelter is part of new construction or retrofit. The risk area population requiring blast protection is approximately 160 million. The very-low-cost options open to the U.S. Government, with its present civil defense budget, remain: (1) maintain the inventory on fallout shelter and identify space with some blast protection potential; (2) plan for crisis upgrading to improve existing space in a crisis, and (3) plan for construction of expedient shelter in a crisis. Fallout shelters might be mandated in appropriate new construction outside risk areas at little cost to the government. Options in the mid-range of expense, a few tens to a few hundreds of dollars per space include: (1) requiring modified limestone-mining practices, where appropriate, to generate useable shelter space near cities; (2) encouraging the construction of earth-sheltered housing and other buildings, and (3) requiring and/or subsidizing the construction of dual-use basement shelter in new construction.

36227 (AD-A—178369/5/XAB) **Enhancing the potential for post-attack recovery. Final report.** (TITAN Systems, Inc., Vienna, VA (USA)). 1 Dec 1986. 145p. NTIS, PC A07/MF A01.

This document contains a series of six papers addressing different actions which, after implementation, could enhance the potential for post-attack recovery. It was produced as part of an overall project which FEMA-NP Directorate tasked to Titan Systems, Inc., in order to support the development of practicable plans and procedures for actions the federal government may take to enhance the probability of national survival and provide an improved basis for long-term recovery should the United States suffer a nuclear attack. The subjects of the paper are: Crisis Dispersal of Pharmaceuticals; Crisis Implementation of EMP Mitigation Procedures at Broadcast Stations; Crisis Dispersal of Petroleum Products; Crisis Dispersal of Transportation Assets; Peacetime EMP Mitigation of Petroleum Facilities; and Industry in Research and Publication of Survival Information.

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The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept (e.g., Pipeline Quality Gas, see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U.S. Department of Commerce, Springfield, VA 22161.

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AC04-84AL24970	**Foster Wheeler Energy Applications, Inc., Livingston, NJ (USA)**	
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AC05-84OT21400	**Oak Ridge Gaseous Diffusion Plant, TN (USA)**	
	12:34588	K/ITP—114
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	Oak Ridge Gaseous Diffusion Plant, TN (USA)	
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AC05-86OR21600	**Westinghouse Materials Co. of Ohio, Cincinnati (USA). Feed Materials Production Center**	
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	12:35066	DOE/ID—10169
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AC07-81NE44139	**West Valley Nuclear Services Co., Inc., West Valley, NY (USA)**	
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AC07-82GJ01706	**Oklahoma Univ., Norman (USA). Energy Resources Inst.**	
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AC08-83NV10282	**EG and G, Inc., Las Vegas, NV (USA). Remote Sensing Lab.**	
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AC08-84NV10322	**Fenix and Scisson, Inc., Mercury, NV (USA)**	
	12:34644	DOE/NV/10322—17
AC09-76SR00001	**Savannah River Lab., Aiken, SC (USA)**	
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	Georgia Inst. of Tech., Atlanta (USA)	
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	GeoTrans, Inc., Herndon, VA (USA)	
	12:35779	DP-MS—86-114
	Savannah River Lab., Aiken, SC (USA)	
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AC21-81FC10297	**Georgia Inst. of Tech., Atlanta (USA). School of Civil Engineering**	
	12:34482	DOE/FC/10297—2334
AC21-83FC10601	**Texas A and M Univ., College Station (USA). Kinetics, Catalysis, and Reaction Engineering Lab.**	
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AC21-84FC10620	**Georgia Inst. of Tech., Atlanta (USA). School of Aerospace Engineering**	
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AC21-84MC21092	**Denver Univ., CO (USA). Dept. of Engineering**	
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AC21-84MC21389	**Coal Tech Corp., Merion, PA (USA)**	
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AC21-84MC21391	**Southwest Research Inst., San Antonio, TX (USA). Fuels and Lubricants Research Div.**	
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AC21-85FC10627	**Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences**	
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AC21-85MC22012	**KOH Systems, Inc., Rockville, MD (USA)**	
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AC21-85MC22109	**North Dakota Univ., Grand Forks (USA). Energy Research Center**	
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AC21-86MC23136	**USDOE Morgantown Energy Technology Center, WV**	
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AC22-86PC90009	**Mobil Research and Development Corp., Paulsboro, NJ (USA)**	
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AC22-87PC90255	**TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.**	
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AC79-81BP25593	**Oregon State Univ., Corvallis (USA). Wind Resources Assessment Lab.**	
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AC79-83BP14969	**Synergic Resources Corp., Bala-Cynwyd, PA (USA)**	
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AC79-84BP18945	United Industries Corp., Bellevue, WA (USA)	
	12:35061	DOE/BP/18945—T6
AC79-84BP18946	URS/TransEnergy Systems, Seattle, WA (USA)	
	12:35062	DOE/BP/18946—T2
AI01-79CS30088	Tennessee Valley Authority, Chattanooga (USA)	
	12:34761	DOE/CS/30088—T1
AI01-85CE50112	Mechanical Technology, Inc., Latham, NY (USA)	
	12:35104	DOE/NASA—0343-1
AI04-80AL13137	Jet Propulsion Lab., Pasadena, CA (USA)	
	12:34767	DOE/JPL—1060-92
AI05-79ET29372	Jet Propulsion Lab., Pasadena, CA (USA)	
	12:34817	DOE/ET/29372—6
AI05-83ER13114	Agricultural Research Service, Ithaca, NY (USA). Northeastern Region	
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AI05-86ER60389	National Bureau of Standards, Washington, DC (USA)	
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AI05-86ER60390	National Bureau of Standards, Washington, DC (USA)	
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AI08-78ET44802	Geological Survey, Reston, VA (USA)	
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AI21-84MC21271	National Bureau of Standards, Boulder, CO (USA). Center for Chemical Engineering	
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AI79-82BP35097	Oregon Dept. of Fish and Wildlife, Clackamas, OR (USA)	
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	Oregon Dept. of Fish and Wildlife, Portland (USA)	
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AI79-84BP18952	Washington Univ., Seattle (USA). School of Fisheries	
	12:35783	DOE/BP/18952—2
AI79-84BP19369	USDOE Bonneville Power Administration, Portland, OR	
	12:34732	DOE/BP—758
AI79-85BP20733	National Marine Fisheries Service, Portland, OR (USA). Environmental and Technical Services Div.	
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AI79-86BP61747	Fish Passage Center, Portland, OR (USA)	
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AM06-70RL02227	Lawrence Berkeley Lab., CA (USA)	
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AP79-86BP61982	USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife	
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AS03-79ER10502	Stanford Univ., CA (USA). Dept. of Chemical Engineering	
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AS03-81ER40029	Washington Univ., Seattle; California Univ., San Diego, La Jolla; Los Alamos National Lab., NM; Harv	
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AS05-76ER05226	Texas A and M Univ., College Station (USA). Dept. of Chemistry	
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AS05-80ER10711	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Center for Transport Theory and Mathematical Physics	
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	Florence Univ. (Italy). Ist. Matematico	
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AS05-80EV10343	Vanderbilt Univ., Nashville, TN (USA). School of Medicine	
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AS05-83ER13053	Univ. of Oklahoma, Norman	
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AS05-83ER13113	Tennessee Univ., Knoxville (USA). Dept. of Chemistry	
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FC02-86CH10252	Fayette Mfg. Corp., Tracy, CA (USA)	
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FC03-83CE11968	Sacramento Municipal Utility District, CA (USA)	
	12:34760	DOE/CE/11968—T1
FC07-80CS40378	Nebraska Univ., Lincoln (USA)	
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FC07-85NV10412	S-Cubed, La Jolla, CA (USA)	
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FC21-83FE60177	Western Research Inst., Laramie, WY (USA)	
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FC22-86PC91272	Southern Illinois Univ., Carbondale (USA). Dept. of Geology	
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FC22-87PC79863	Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center	
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FC79-85BP22515	Bonneville Power Administration, Portland, OR (USA)	
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FG01-85CE15231	Reich (Douglas R.), North Fort Myers, FL (USA)	
	12:35063	DOE/CE/15231—T5
FG01-85CE15240	Ball State Univ., Muncie, IN (USA). Center for Energy Research/Education/Service	
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FG01-85CE40732	ACEC Research and Management Foundation, Washington, DC (USA)	
	12:34997	DOE/CE/40732—T4
FG01-86CE15270	Missouri Univ., Columbia (USA). School of Forestry, Fisheries and Wildlife	
	12:35851	DOE/CE/15270—T2
FG01-86CE15278	AV-YO, Inc., Haleiwa, HI (USA)	
	12:34800	DOE/CE/15278—T3
FG01-86CE63478	Arrowhead Economic Opportunity Agency, Virginia, MN (USA)	
	12:35028	DOE/CE/63478—T4
FG01-86CE63480	WAMY Community Action Agency, Inc., Boone, NC (USA)	
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FG02-84ER13183	Wisconsin Univ., Madison (USA)	
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FG02-84ER13299	Colorado State Univ., Fort Collins	
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FG02-84ER45055	Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering	
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FG02-84ER45165	Brown Univ., Providence, RI (USA). Metals Research Lab.	
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FG02-85ER13369	Michigan State Univ., East Lansing (USA)	
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FG02-85ER13440	Nebraska Univ., Lincoln (USA). Dept. of Physics and Astronomy	
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FG02-85ER45213	Pittsburgh Univ., PA (USA). Dept. of Materials Science and Engineering	
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FG02-85ER53205	Connecticut Univ., Storrs (USA). Dept. of Physics	
	12:35943	DOE/ER/53205—T2
FG02-86CH10287	Tuskegee Inst., AL (USA). Carver Research Foundation	
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	Tuskegee Inst., AL (USA)	
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FG02-86ER13529	Ohio State Univ., Columbus (USA). Dept. of Chemistry	
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FG02-86ER13615	Pennsylvania Univ., Philadelphia (USA). Dept. of Chemistry	
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FG02-86ER13620	Arizona State Univ., Tempe (USA). Dept. of Chemistry	
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FG02-86ER40243	Yale Univ., New Haven, CT (USA). Dept. of Physics	
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FG02-86ER40304	City Coll., New York (USA). Dept. of Physics	
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FG02-86ER45260	Dartmouth Coll., Hanover, NH (USA). Thayer School of Engineering	
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FG02-86ER53222	Columbia Univ., New York (USA). Plasma Physics Lab.	
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FG02-86ER60397	East Anglia Univ. (UK). Climatic Research Unit	
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FG02-86ER60439	Columbia Univ., New York (USA). Nevis Labs.	
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FG02-86ER60487	Cincinnati Univ., OH (USA). Dept. of Chemistry	
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FG02-87ER25026	Illinois Univ., Urbana (USA). Dept. of Computer Science	
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FG02-87ER40315	Carnegie-Mellon Univ., Pittsburgh, PA (USA)	
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FG03-85CE90229	Wiley (John) and Sons, New York (USA)	
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FG03-86ER52130	California Univ., Los Angeles (USA). Center for Plasma Physics and Fusion Engineering	
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FG03-87ER25028	Stanford Univ., CA (USA). Systems Optimization Lab.	
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FG05-83OR21390	Council of Great Lakes Governors, Inc., Madison, WI (USA)	
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FG05-84ER13281	Texas Tech Univ., Lubbock (USA). Dept. of Chemistry and Biochemistry	
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FG05-84ER45155	Florida Univ., Gainesville (USA)	
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FG05-85ER13420	Optical Society of America, Washington, DC	
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FG05-85ER13447	Florida Univ., Gainesville (USA). Dept. of Physics	
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FG05-85ER13456	Tennessee Univ., Knoxville (USA). Dept. of Physics	
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FG05-85ER60373	Duke Univ., NC	
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FG05-86ER40272	Florida Univ., Gainesville (USA). Dept. of Physics	
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FG05-86ER40297	Florida Agricultural and Mechanical Univ., Tallahassee (USA)	
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FG05-86ER45257	Georgia Inst. of Tech., Atlanta (USA). Fracture and Fatigue Research Lab.	
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FG05-86ER60411	Tennessee Univ., Knoxville (USA). Inst. of Resonance Ionization Spectroscopy	
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FG07-83ID12380	Massachusetts Inst. of Tech., Cambridge (USA)	
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FG21-85LC11067	Cliffs Engineering, Inc., Rifle, CO (USA)	
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FG22-83PC60036	Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering	
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FG22-83PC60797	Southern Illinois Univ., Carbondale (USA). Dept. of Mechanical Engineering and Energy Processes	
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FG22-84PC70808	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
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FG22-85PC80517	Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering	
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FG22-85PC80522	North Dakota Univ., Grand Forks (USA). Dept. of Chemistry	
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FG22-85PC80526	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
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FG22-85PC80536	Grambling State Univ., LA (USA)	
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FG22-85PC81544	Colorado Univ., Denver (USA). Dept. of Chemistry	
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FG22-86PC90958	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
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FG22-86PC91101	Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry	
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FG22-86PC91405	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
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Grant AC03-76SF00098	California Univ., Berkeley; Lawrence Berkeley Lab., CA; Rome-2 Univ., Italy; Istituto Nazionale di F	
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	Lawrence Livermore National Lab., CA (USA)	
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	12:35529	UCID—21070
	12:35530	UCRL—92403
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CONF-8508234-	(International machine tool research forum, Chicago, IL, USA, 20-21 Aug 1985)				
1	*See* UCRL-92987	E 1.99:	DE87008741	MN -38	12:35378
CONF-850903-	(International topical meeting on computer applications for nuclear power plant operation and control, Pasco, WA, USA, 8-12 Sep 1985)				
31	*See* HEDL-SA-3300	E 1.99:	DE87010415	MN -80	12:34851
CONF-850925-	(3. international symposium on radiation physics, Ferrara, Italy, 30 Sep-4 Oct 1985)				
	, 255: No. 1/2, 207-212(15 Mar 1987)				12:35518
	, 255: No. 1/2, 317-325(15 Mar 1987)				12:35519
CONF-8509398-	(IAEA advisory group meeting on nuclear and atomic data for radiotherapy and radiobiology, Rijswijk, Netherlands, 16-20 Sep 1985)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011187	MN -34C	12:36079
CONF-851053-	(7. international workshop on laser interaction and related plasma phenomena, Monterey, CA, USA, 28 Oct-1 Nov 1985)				
19	*See* UCRL-94327	E 1.99:	DE87009606	MN -21	12:36096
CONF-8510219-	(IEEE ultrasonics symposium, San Francisco, CA, USA, 16-18 Oct 1985)				
2	*See* UCRL-93487	E 1.99:	DE87008739	MN -38	12:35411

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
CONF-851145-	(9. annual training resources and data exchange conference, Rockville, MD, USA, 4-6 Nov 1985)			
1	*See* HEDL-SA-3409	E 1.99: DE87010723	MN -41	12:35826
CONF-8511123-	(2. international technical symposium on optical and electro-optical applied science and engineering, Cannes, France, 25 Nov-6 Dec 1985)			
7	*See* UCRL-92403	E 1.99: DE87008757	MN -38	12:35530
CONF-8511129-	(RAWG robotic and automation workshop, Los Alamos, NM, USA, 21-22 Nov 1985)			
5	*See* HEDL-SA-3397	E 1.99: DE87010409	MN -16	12:36198
CONF-860117-	(Los Angeles symposium and exhibition on optical and electro-optical engineering, Los Angeles, CA, USA, 19-24 Jan 1986)			
14	*See* UCRL-93856	E 1.99: DE87009597	MN -38	12:35531
18	*See* UCRL-93934	DE87009605	MN -38	12:35532
CONF-860123-	(65. annual meeting of the Appalachian Society of American Foresters: atmospheric deposition and forest productivity, Raleigh, NC, USA, 30-31 Jan 1986)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009824	MN -11	12:35583
CONF-8603121-	(Special Sanibel symposium, St. Augustine, FL, USA, 8 Mar 1986)			
Pt.2	*See* DOE/ER/60420-1	TI87009263	ND -4	12:36108
CONF-8606215-	(Summer study on the physics of the superconducting super collider, Snowmass, CO, USA, 23 Jun-11 Jul 1986)			
42	*See* FNAL/C-87/51	E 1.99: DE87009437	MN -34D	12:35974
43	*See* FNAL/C-87/54	E 1.99: DE87010081	MN -34D	12:35975
CONF-8606259-	(Theoretical Advanced Study Institute conference, Santa Cruz, CA, USA, 23 Jun-29 Jul 1986)			
6	*See* SLAC-PUB-4284	E 1.99: DE87010546	MN -34D	12:35981
CONF-8606312-	(Summer workshop on high energy physics and cosmology, Trieste, Italy, 30 Jun-15 Aug 1986)			
1	*See* SLAC-PUB-4136	E 1.99: DE87003268	MN -34D	12:36023
CONF-860722-	(ASME pressure vessel and piping conference and exhibit, Chicago, IL, USA, 20-24 Jul 1986)			
27	*See* HEDL-SA-3297-FP	TI87008384	ND -25	12:35137
CONF-860829-	(Annual joint meeting of the Electron Microscopy Society of America and the Microbeam Analysis Society, Albuquerque, NM, USA, 10-15 Aug 1986)			
42	*See* LBL-23387	E 1.99: DE87011098	MN -25	12:35526
CONF-8608174-	(Workshop on economic feasibility of food irradiation applications, Wageningen, Netherlands, 25 Aug-5 Sep 1986)			
1	*See* CEA-CONF-8689	DE87752086	MN -23	12:35809
2	*See* CEA-CONF-8687	DE87752087	MN -23	12:35808
CONF-8608179-	(Annual Illuminating Engineering Society conference, Boston, MA, USA, 16-23 Aug 1986)			
2	*See* LBL-22360	E 1.99: DE87010280	MN -95	12:35032
CONF-860931-	(International conference on reliable fuels for liquid metal reactors, Tucson, AZ, USA, 7-11 Sep 1986)			
14	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87004993	MN -79b	12:34868
CONF-860948-	(3. annual Pittsburgh coal conference, Pittsburgh, PA, USA, 8-12 Sep 1986)			
Summs.	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87008188	MN -102	12:34454
CONF-860950-	(17. international congress on high speed photography and photonics, Pretoria, South Africa, 1-5 Sep 1986)			
3	*See* UCRL-93074	DE87008742	MN -38	12:35548
CONF-8609132-	(Resonance ionization spectroscopy and its application, Swansea, UK, 7-12 Sep 1986)			
	IOP Publishing Ltd., Redcliffe Way, Bristol Way, Bristol BS1 6NX, England	TI87010199		12:35953
CONF-8609142-	(Lattice gauge theory meeting, Upton, NY, USA, 15-19 Sep 1986)			
4	*See* BNL-39764	E 1.99: DE87010441	MN -34D	12:35992
5	*See* BNL-39787	DE87010438	MN -34D	12:36019
CONF-8609151-	(7. international symposium on high energy spin physics, Protvino, USSR, 22-27 Sep 1986)			
7	*See* DOE/ER/40150-16	E 1.99: DE87008670	MN -34D	12:35970
CONF-8609163-	(International conference and symposia on unified concepts of many-body problems, Stony Brook, NY, USA, 4-6 Sep 1986)			
11	*See* LA-UR-87-1707	E 1.99: DE87010125	MN -34	12:36090
12-Prepr.	*See* GSI-86-45-Prepr.		ND -34C	12:36057
CONF-8609215-	(Ispra courses: regional and long-range transport of air pollution, Ispra, Varese, Italy, 15-19 Sep 1986)			
2	*See* BNL-39588	E 1.99: DE87010059	MN -11	12:35582
CONF-8609234-	(International collaboration on advanced neutron sources, Villigen, Switzerland, 22-26 Sep 1986)			
7	*See* LA-UR-87-1156	E 1.99: DE87008988	MN -28	12:35491
CONF-8609273-	(1. Franco-Argentin symposium on materials science, Mar del Plata, Argentina, 29 Sep-3 Oct 1986)			
1	*See* CEA-CONF-8725	DE87752094	MN -80	12:34839

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CONF-8609286-	(BIO Technica '86: 2nd international exhibition and congress for biotechnology, Hannover, F.R. Germany, 23-25 Sep 1986)			
Absts.	NTIS (US Sales Only), PC A04/MF A01; 1	DE87752432	MN -61E	12:34740
CONF-8609287-	(ECONMIG 86: European conference on numerical methods in geomechanics, Stuttgart, F.R. Germany, 16-18 Sep 1986)			
Vol.1	NTIS (US Sales Only), PC A09; 3	DE87752435	MN -11	12:35889
CONF-8610115-	(4. international symposium on the production and neutralization of negative ions and beams, Upton, NY, USA, 27-31 Oct 1986)			
25	*See* LBL-22387	E 1.99: DE87010283	MN -20a	12:36154
26	*See* LBL-22299	DE87010286	MN -20a	12:35945
CONF-8610135-	(14. water reactor safety information meeting, Gaithersburg, MD, USA, 27-31 Oct 1986)			
48	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87004832	MN -78	12:34820
CONF-8610173-	(11. conference on cyclotrons and their applications, Tokyo, Japan, 13-17 Oct 1986)			
16	*See* LBL-21738	E 1.99: DE87009170	MN -28	12:35493
CONF-8610271-	(10. national conference on particle accelerators, Dubna, USSR, 21-23 Oct 1986)			
1	*See* LBL-22715	E 1.99: DE87009174	MN -28	12:35445
CONF-8610279-	(EPRI/NSAC annual independent safety analysis group conference, Houston, TX, USA, 21-22 Oct 1986)			
1	*See* DP-MS-86-152	E 1.99: DE87010188	MN -41	12:34869
CONF-8610282-	(Integrated pest management training program conference, Hyderabad, India, 1-31 Oct 1986)			
1	*See* BNL-39714	E 1.99: DE87010065	MN -11	12:35807
CONF-8610286-	(11. annual joint firing systems conference, Albuquerque, NM, USA, 15-16 Oct 1986)			
1-Summ.	*See* UCRL-95507	DE87010872	MN -35	12:35549
CONF-861102-	(American Nuclear Society and Atomic Industrial Forum joint meeting, Washington, DC, USA, 16-21 Nov 1986)			
44	*See* HEDL-SA-3546	E 1.99: DE87009975	MN -79b	12:34859
46	*See* BNL-39114	DE87008707	MN -48	12:35791
CONF-861106-	(IAEA international conference on plasma physics and controlled nuclear fusion research, Kyoto, Japan, 12-19 Nov 1986)			
25	*See* IAEA-CN-47/I-I-6	E 1.99: DE87008812	MN -21	12:36153
CONF-861138-	(99. annual meeting and exposition of the Geological Society of America, San Antonio, TX, USA, 10-13 Nov 1986)			
1	*See* DP-MS-86-179	E 1.99: DE87010163	MN -11	12:35729
CONF-861146-	(AIChE winter annual meeting, Miami, FL, USA, 2-7 Nov 1986)			
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34456
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34457
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34481
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34610
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34682
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34683
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34684
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34724
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34815
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:34844
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35190
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35345
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35383
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35405
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35406
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35407
	American Institute of Chemical Engineers, 345 East 47 St., New York, NY 10017			12:35506
CONF-861147-	(Symposium on the future of geothermal energy, San Diego, CA, USA, 17-18 Nov 1986)			
2	*See* LBL-22487	E 1.99: DE87010282	MN -66a	12:34792

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CONF-8611109-	(IAEA technical committee meeting on water reactor fuel behaviour and fission products release in off-normal and accident conditions, Vienna, Austria, 10-13 Nov 1986)				
6	*See* IAEA-TC-579/21		DE87900496	MN -78	12:34879
CONF-8611150-	(International conference on non-military radiation emergencies, Washington, DC, USA, 19-21 Nov 1986)				
3	*See* LA-UR-87-1376		DE87009005	MN -41	12:35836
4	*See* BNL-39618	E 1.99:	DE87008448	MN -41	12:35819
CONF-8611155-	(3. Australian Institute of Nuclear Science and Engineering conference on neutron scattering, Lucas Heights, Australia, 6-7 Nov 1986)				
1	*See* PPA-T-57		DE87702405	MN -34C	12:36062
CONF-8611159-	(Seminar on nuclear data, Tokai, Japan, 26-27 Nov 1986)				
	See NEANDC(J)-123/U		TI87900676	STD -34C	12:36039
CONF-861207-	(Materials Research Society fall meeting, Boston, MA, USA, 1-5 Dec 1986)				
107	*See* DOE/ER/45213-5	E 1.99:	DE87008833	MN -25	12:35128
108	*See* UCRL-95427	E 1.99:	DE87010274	MN -25	12:35241
CONF-870102-	(4. symposium on space nuclear power systems, Albuquerque, NM, USA, 12-16 Jan 1987)				
2	NTIS, PC A02/MF A01; 1		DE87007004	MN -80	12:34829
23	*See* BNL-39695	E 1.99:	DE87010060	MN -80	12:34838
24	*See* BNL-39696	E 1.99:	DE87010066	MN -80	12:34863
CONF-870116-	(International conference on stability of amorphous silicon alloy materials and devices, Palo Alto, CA, USA, 28-30 Jan 1987)				
Summs.	*See* SERI/CP-211-3090	E 1.99:	DE87001122	MN -63e	12:34751
CONF-870121-	(Meeting of the Division of Particles and Fields of the American Physical Society, Salt Lake City, UT, USA, 14-17 Jan 1987)				
6R	*See* BNL-39471	E 1.99:	DE87008708	MN -34C	12:35959
7	*See* BNL-39658		DE87010049	MN -34C	12:35989
CONF-870151-	(Irvine conference on non-perturbative methods in field theory, Laguna Beach, CA, USA, 7 Jan 1987, 7 Jan 1987)				
2	*See* LBL-23028		DE87008230	MN -34D	12:36021
CONF-870165-	(Workshop on electronuclear physics with internal targets, Stanford, CA, USA, 5-8 Jan 1987)				
4	*See* LBL-23108	E 1.99:	DE87009156	MN -34D	12:35999
5	*See* UCRL-96590	E 1.99:	DE87009575	MN -34C	12:35515
CONF-870204-	(Society of Automotive Engineers international congress and expo, Detroit, MI, USA, 23-27 Feb 1987)				
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35088
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35089
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35090
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35091
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35092
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35093
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35094
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35095
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35096
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35097
	Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096				12:35105
CONF-870252-	(Solving ground water problems with models conference, Denver, CO, USA, 10-12 Feb 1987)				
8	*See* DP-MS-86-114	E 1.99:	DE87010198	MN -11	12:35779
CONF-870260-	(International workshop hadron facility technology, Santa Fe, NM, USA, 2-5 Feb 1987)				
4	*See* LA-UR-87-1253	E 1.99:	DE87008994	MN -28	12:35492
CONF-870263-	(Photovoltaics annual systems symposium, Austin, TX, USA, 18-20 Feb 1987)				
Summs.	*See* SAND-87-0097	E 1.99:	DE87006334	MN -63	12:34763
CONF-870279-	(Lake Louise winter institute, Alberta, Canada, 15-21 Feb 1987)				
3	*See* LBL-23038	E 1.99:	DE87009160	MN -34D	12:35998
7	*See* TRI-PP-87-19		DE87900668	MN -34D	12:35983
8	*See* TRI-PP-87-17		DE87900667	MN -34D	12:36024
CONF-870283-	(BNL neutrino workshop, Upton, NY, USA, 5-7 Feb 1987)				
2	*See* BNL-39636	E 1.99:	DE87009143	MN -28	12:35481

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4	*See* BNL-39727	E 1.99: DE87010061	MN -34D	12:35991
5	*See* BNL-39629	E 1.99: DE87010051	MN -34D	12:35960
6	*See* BNL-39675	E 1.99: DE87010048	MN -34D	12:35990
8	*See* BNL-39667	E 1.99: DE87010058	MN -34D	12:35961
9	*See* BNL-39668	E 1.99: DE87010068	MN -34D	12:35962
CONF-870290-	(OECD/NEA workshop on uncertainty analysis for systems performance assessments, Seattle, WA, USA, 24-26 Feb 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009668	MN -80	12:36190
CONF-870302-	(Particle accelerator conference, Washington, DC, USA, 16-19 Mar 1987)			
85	*See* BNL-39477	E 1.99: DE87007630	MN -28	12:35477
109	*See* LBL-22143	E 1.99: DE87008227	MN -28	12:35494
115	*See* BNL-39550	E 1.99: DE87008451	MN -28	12:35478
120	*See* SLAC-PUB-4204	E 1.99: DE87008873	MN -28	12:35501
122	*See* SLAC-PUB-4096	E 1.99: DE87008871	MN -28	12:35469
123	*See* SLAC-PUB-4100	E 1.99: DE87008870	MN -28	12:35500
124	*See* SLAC-PUB-4231	E 1.99: DE87008869	MN -28	12:35503
125	*See* SLAC-PUB-4088	E 1.99: DE87008867	MN -28	12:35468
126	*See* SLAC-PUB-4220	E 1.99: DE87008875	MN -28	12:35473
127	*See* SLAC-PUB-4099	E 1.99: DE87008863	MN -28	12:35499
128	*See* SLAC-PUB-4090	E 1.99: DE87008865	MN -28	12:35498
129	*See* SLAC-PUB-4184	E 1.99: DE87008866	MN -28	12:35471
130	*See* SLAC-PUB-4087	E 1.99: DE87008868	MN -34D	12:35467
134	*See* FNAL-TM-1441	DE87009034	STD -28	12:35457
135	*See* LA-UR-87-872	E 1.99: DE87008985	MN -28	12:35490
137	*See* LBL-22194	E 1.99: DE87009168	MN -28	12:35461
139	*See* LBL-22166	DE87009157	MN -28	12:35443
141	*See* BNL-39608	E 1.99: DE87008711	MN -28	12:35454
142	*See* BNL-39609	E 1.99: DE87008712	MN -28	12:35455
143	*See* BNL-39606	E 1.99: DE87008709	MN -28	12:35480
144	*See* BNL-39607	E 1.99: DE87008710	MN -28	12:35453
145	*See* FNAL-TM-1449	DE87009036	STD -28	12:35441
146	*See* FNAL-TM-1443	DE87009035	STD -28	12:35487
148	*See* FNAL-TM-1445	DE87009029	STD -28	12:35458
149	*See* FNAL-TM-1447	DE87009030	STD -28	12:35488
155	*See* LBL-22212	E 1.99: DE87009162	MN -28	12:35463
157	*See* LBL-22191	E 1.99: DE87009167	MN -28	12:35495
158	*See* BNL-39551	E 1.99: DE87009144	MN -28	12:35479
161	*See* LBL-22094	E 1.99: DE87009329	MN -28	12:35460
163	*See* LBL-22168	DE87009330	MN -28	12:35444
165	*See* SLAC-PUB-4263	DE87009450	MN -28	12:35448
166	*See* LBL-22201	DE87009624	MN -28	12:35462
167	*See* SLAC-PUB-4230	DE87009451	MN -28	12:35474
168	*See* SLAC-PUB-4219	DE87009452	MN -28	12:35502
171	*See* LBL-22273	E 1.99: DE87009547	MN -28	12:35496
174	*See* LBL-22214	DE87009549	MN -28	12:35464
177	*See* SLAC-PUB-4097	DE87009458	MN -34D	12:35470
178	*See* LBL-22274	DE87009552	MN -28	12:35497
179	*See* SLAC-PUB-4206	DE87009456	MN -28	12:35446
180	*See* LBL-22275	E 1.99: DE87009446	MN -28	12:35465
182	*See* SLAC-PUB-4189	E 1.99: DE87009892	MN -28	12:35472
183	*See* BNL-39595	E 1.99: DE87010054	MN -28	12:35452
188	*See* BNL-39674	E 1.99: DE87010454	MN -41	12:35820
190	*See* BNL-39670	E 1.99: DE87010456	MN -28	12:35482
CONF-870306-	(Waste management '87, Tucson, AZ, USA, 1-5 Mar 1987)			
48	*See* EGG-M-29486	E 1.99: DE87009396	MN -71	12:34855
50	*See* EGG-M-28586	E 1.99: DE87009403	MN -70B	12:34648
51	*See* EGG-M-29286	E 1.99: DE87009412	MN -70B	12:34649
52	*See* RHO-RE-SA-170P	E 1.99: DE87008698	MN -70B	12:34669
53	*See* DP-MS-87-25	DE87010187	MN -11	12:35740
54	*See* RHO-RE-SA-177-P	E 1.99: DE87010666	MN -70B	12:34670
CONF-870340-	(International symposium on atomic, molecular and solid state theory, scattering problems, many-body phenomena, and computational methods, St. Augustine, FL, USA, 16-21 Mar 1987)			
2	*See* LBL-23257	E 1.99: DE87009644	MN -34	12:36092
CONF-870388-	(International conference on metallurgical coatings, San Diego, CA, USA, 23-27 Mar 1987)			
9	*See* PNL-SA-14488	E 1.99: DE87011149	MN -25	12:35145
CONF-870390-	(22. Recontres de Moriond: electroweak interactions and unified theories conference, Les Arcs, France, 8-15 Mar 1987)			
4	*See* DOE/ER/13065-487	E 1.99: DE87010233	MN -34D	12:35968
7	*See* SLAC-PUB-4332	E 1.99: DE87011596	MN -34D	12:35982
CONF-8703118-	(NATO advanced study institute conference on time dependent effects in disordered materials, Geilo, Norway, 29 Mar-9 Apr 1987)			
2	NTIS. PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008587	MN -25	12:35125
CONF-8703121-	(Telemark IV - neutrino mass and neutrino astrophysics, Ashland, WI, USA, 16-18 Mar 1987)			
2	*See* BNL-39737	E 1.99: DE87010449	MN -34D	12:35963
3	*See* SLAC-PUB-4281	DE87009449	MN -34D	12:35980

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CONF-8703125-	(Geological Society of America - Southeastern section meeting, Norfolk, VA, USA, 26-27 Mar 1987)			
1-Abst.	*See* DP-MS-86-180	E 1.99: DE87010171	MN -11	12:35877
CONF-8703131-	(19. symposium on the interface of computer science and statistics, Philadelphia, PA, USA, 8-11 Mar 1987)			
1	NTIS, PC A02; 3	DE87010020	MN -32	12:36193
CONF-8703134-	(JANNAF propulsion systems hazards subcommittee, Redstone Arsenal, AL, USA, 30 Mar-3 Apr 1987)			
1	*See* SAND-86-2585C	E 1.99: DE87008521	MN -4	12:36095
CONF-8703135-	(International conference on radiation dosimetry and safety, Taipei, Taiwan, 2-4 Mar 1987)			
1	*See* EGG-M-04587	E 1.99: DE87009395	MN -41	12:35825
CONF-8703136-	(Elementary structure of materials, Les Houches, France, 24 Mar-2 Apr 1987)			
1	*See* BNL-39781	E 1.99: DE87010439	MN -34D	12:36018
CONF-8703137-	(American Public Power Association's engineering and operations workshop, Nashville, TN, USA, 16-19 Mar 1987)			
Exc.	*See* TVA/OP/EDT-87/21	DE87900610	MN -97	12:35014
CONF-8703139-	(Economics of eastern hardwood management conference, University Park, PA, USA, 9-11 Mar 1987)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008807	MN -11	12:35810
CONF-8703143-	(Workshop on superstrings, composite structures, and cosmology, College Park, MD, USA, 11-18 Mar 1987)			
1	*See* FNAL/C-87/86-A	E 1.99: DE87010909	MN -34B	12:35918
CONF-870405-	(Radiation protection and shielding conference, Knoxville, TN, USA, 22-24 Apr 1987)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE86015178	MN -79d	12:36078
CONF-870410-	(193. national meeting of the American Chemical Society, Denver, CO, USA, 5-10 Apr 1987)			
20	*See* MLM-3429(OP)	DE87009198	MN -70	12:36155
23	*See* LBL-23365	E 1.99: DE87010257	MN -34C	12:36053
24	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009816	MN -11	12:35848
26	*See* PNL-SA-14672	E 1.99: DE87010865	MN -61D	12:34723
CONF-870412-	(General meeting of the American Physical Society, Crystal City, VA, USA, 20-24 Apr 1987)			
1	*See* LA-UR-87-1517	E 1.99: DE87010103	MN -34	12:35394
CONF-870416-	(14. annual energy technology conference and exposition, Washington, DC, USA, 14-16 Apr 1987)			
6	*See* PNL-SA-14612	E 1.99: DE87011151	MN -13	12:34992
CONF-870422-	(89. annual meeting of the American Ceramic Society, Pittsburgh, PA, USA, 26-30 Apr 1987)			
4	*See* DP-MS-87-2	E 1.99: DE87010182	MN -4	12:34647
CONF-870424-	(American Nuclear Society international meeting on advances in reactor physics, mathematics and computation, Paris, France, 27-30 Apr 1987)			
12	*See* SAND-87-0748C	E 1.99: DE87007681	MN -66b	12:35888
CONF-870430-	(International conference on methods and applications of radioanalytical chemistry, Kona, HI, USA, 5-10 Apr 1987)			
5	*See* UCRL-95153	E 1.99: DE87009746	MN -11	12:35745
8	*See* LBL-23366	E 1.99: DE87010095	MN -4	12:35357
9	*See* LBL-23158	E 1.99: DE87010287	MN -70	12:34655
10	*See* PNL-SA-14251	E 1.99: DE87011150	MN -4	12:35296
CONF-870438-	(Spring meeting of the Materials Research Society, Anaheim, CA, USA, 21-25 Apr 1987)			
16	*See* BNL-39689	E 1.99: DE87010047	MN -25	12:35195
18	*See* SAND-87-1394C	E 1.99: DE87010478	MN -4	12:35147
19	*See* SAND-86-2804C	E 1.99: DE87010684	MN -25	12:35202
26	*See* SAND-86-2751C	E 1.99: DE87011287	MN -25	12:35201
CONF-870474-	(Robotics II conference, Chicago, IL, USA, 26-30 Apr 1987)			
2	*See* DP-MS-86-191	E 1.99: DE87010189	MN -38	12:35366
CONF-870498-	(7. tandem conference, Berlin, F.R. Germany, 6-10 Apr 1987)			
1	*See* UCRL-96013	E 1.99: DE87008422	MN -28	12:35450
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008828	MN -28	12:35484
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009671	MN -28	12:35438
CONF-870499-	(7. western regional energy division conference, Richland, WA, USA, 19-21 Apr 1987)			
2	*See* HEDL-SA-3696	E 1.99: DE87009969	MN -79	12:34860
CONF-8704110-	(5. geothermal program review, ,Washington, DC, USA, 14-15 Apr 1987)			
9	*See* PNL-SA-14847	E 1.99: DE87011140	MN -66b	12:34796
CONF-8704111-	(Forced flow through fractured rock masses, Garcy, France, 13-15 Apr 1987)			
2	*See* LA-UR-87-1256	E 1.99: DE87008996	MN -66a	12:34794
CONF-8704116-	(IMOG metal forming modeling subgroup, Livermore, CA, USA, 22-24 Apr 1987)			
1-Abst.	*See* SAND-87-1057C	E 1.99: DE87008518	MN -38	12:35146
CONF-8704124-	(5. annual Department of Energy geothermal program review, Alexandria, VA, USA, 14 Apr 1987)			
1	*See* BNL-39626	E 1.99: DE87010447	MN -66d	12:34793

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
CONF-8704125-	(3. international conference on carcinogenic and mutagenic N-substituted aryl compounds, Dearborn, MI, USA, 25-28 Apr 1987)			
2	*See* UCRL-96831	E 1.99: DE87011347	MN -48	12:35864
CONF-8704126-	(VIM conference, Ottawa, Canada, 27 Apr 1987)			
3	*See* BDX-613-3762	E 1.99: DE87009392	MN -32	12:36189
CONF-8704136-	(11. biennial workshop on color aerial photography in the plant sciences, Weslaco, TX, USA, 27 Apr-1 May 1987)			
1	*See* DP-MS-86-210	E 1.99: DE87010202	MN -11	12:35713
CONF-8704137-	(MGUS '87, Redwood City, CA, USA, 13-15 Apr 1987)			
1	*See* LA-UR-87-1150	E 1.99: DE87008987	MN -32	12:36200
CONF-8704146-	(Annual conference of the New Mexico chapter of the American Society of Safety Engineers, Albuquerque, NM, USA, 30 Apr-1 May 1987)			
1-Summ.	*See* SAND-87-1129C	E 1.99: DE87009078	MN -41	12:34549
CONF-870507-	(13. international hot atom chemistry symposium, Mount Fuji, Japan, 24-29 May 1987)			
1	*See* BNL-39712	E 1.99: DE87010057	MN -4	12:35354
CONF-870516-	(5. international symposium on gaseous dielectrics, Knoxville, TN, USA, 3-7 May 1987)			
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008806	MN -34A	12:35938
CONF-870519-	(9. annual meeting of the European Safeguards Research and Development Association: safeguards and nuclear material management, London, UK, 12-14 May 1987)			
3	*See* LA-UR-87-1279	E 1.99: DE87008999	MN -15	12:34698
4	*See* MLM-3438(OP)	E 1.99: DE87010369	MN -16	12:34700
6	*See* LA-UR-87-1504	DE87010101	MN -15	12:34699
7	*See* LA-UR-87-1576	DE87010113	MN -15	12:34595
CONF-870523-	(9. symposium on biotechnology for fuels and chemicals, Boulder, CO, USA, 5-8 May 1987)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010013	MN -61E	12:34739
CONF-870525-	(Workshop on development of personal neutron dosimeters based on track etch detectors, Harwell, UK, 12-14 May 1987)			
1	*See* UCRL-95780	E 1.99: DE87010271	MN -25	12:35514
CONF-870538-	(19. IEEE photovoltaic specialists conference, New Orleans, LA, USA, 4-8 May 1987)			
13	*See* SAND-87-1159C	E 1.99: DE87009294	MN -63	12:34766
CONF-870552-	(5. conference on real-time computer applications in nuclear particle and plasma physics, San Francisco, CA, USA, 11-15 May 1987)			
12	*See* FNAL/C-87/76	E 1.99: DE87010567	MN -34D	12:35486
14	*See* LA-UR-87-1541	E 1.99: DE87010107	MN -32	12:36201
CONF-870557-	(Executive conference on low-level and mixed waste disposal: the public and the science, Bethesda, MD, USA, 3-6 May 1987)			
1-Vugraphs	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009025	MN -70B	12:34638
CONF-870584-	(Technical symposium southeast on optics, electro-optics and sensors, Orlando, FL, USA, 17-22 May 1987)			
3	*See* UCRL-95366	E 1.99: DE87009573	MN -28	12:35475
4	*See* UCRL-96551	E 1.99: DE87009851	MN -38	12:35397
6	*See* UCRL-96594	E 1.99: DE87010336	MN -37	12:35535
CONF-8705101-	(IAEA/IWGFR specialists' meeting on fission and corrosion products in primary systems of LMFBR's, Karlsruhe, F.R. Germany, 5-8 May 1987)			
1	*See* HEDL-SA-3689	E 1.99: DE87009516	MN -79	12:34828
CONF-8705105-	(1. CODATA workshop on nucleic acid and protein sequencing data, Gaithersburg, MD, USA, 3-6 May 1987)			
3	*See* BNL-39749	E 1.99: DE87010043	MN -48	12:35787
CONF-8705109-	(IMPACT '87, Bremen, F.R. Germany, 18-21 May 1987)			
5	*See* LA-UR-87-1609	E 1.99: DE87010115	MN -25	12:35143
6	*See* LA-UR-87-1585	E 1.99: DE87010114	MN -25	12:35142
CONF-8705116-	(NATO RSG5 meeting, Portsmouth, UK, 11 May 1987)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009679	MN -41	12:35821
CONF-8705120-	(NATO advanced workshop on narrow band phenomena, Staverden, Netherlands, 31 May-5 Jun 1987)			
1	*See* UCRL-96688	E 1.99: DE87010339	MN -34	12:36097
CONF-870601-	(Annual meeting of the American Nuclear Society, Dallas, TX, USA, 7-12 Jun 1987)			
11	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87005692	MN -70	12:34639
CONF-870623-	(22. AIAA thermophysics conference, Honolulu, HI, USA, 8-10 Jun 1987)			
5	*See* SAND-86-2762C	E 1.99: DE87010039	MN -38	12:35374
8	*See* LA-UR-87-1737	DE87010128	MN -34	12:36091
CONF-870636-	(5. national congress on pressure vessels and piping, San Diego, CA, USA, 28 Jun-2 Jul 1987)			
10	*See* HEDL-SA-3642	DE87009970	MN -79	12:34842

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
CONF-870642-	(3. national conference on utility DSM programs: demand-side management strategies in transition, Houston, TX, USA, 16-18 Jun 1987)				
4	*See* PNL-SA-14814	E 1.99:	DE87011154	MN -97	12:35013
CONF-870659-	(7. annual gasification systems conference, Morgantown, WV, USA, 16-19 Jun 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010899	MN -106	12:34458
CONF-870671-	(International symposium on prediction and performance in geotechnical engineering, Calgary, Alberta, Canada, 17-19 Jun 1987)				
1	*See* SLAC-PUB-4211		DE87006778	MN -28	12:35447
CONF-870676-	(4. international conference on solid-state sensors and actuators, Tokyo, Japan, 2-5 Jun 1987)				
2	*See* SAND-87-0716C	E 1.99:	DE87007679	MN -37	12:35528
CONF-870677-	(6. IMACS international symposium on computer methods for partial differential equations, Bethlehem, PA, USA, 23-26 Jun 1987)				
6	*See* UCRL-96615	E 1.99:	DE87009849	MN -32	12:36216
CONF-870692-	(14. transducer workshop, Colorado Springs, CO, USA, 16 Jun 1987)				
2	*See* SAND-87-0154C		DE87010037	MN -37	12:35527
CONF-8706103-	(NATO advanced study institute on alloy phase stability, Crete, Greece, 14-27 Jun 1987)				
2	*See* UCRL-96671	E 1.99:	DE87010877	MN -25	12:35149
CONF-8706108-	(Maintenance seminar, Oak Ridge, TN, USA, 2-3 Jun 1987)				
1	*See* SAND-87-1378C	E 1.99:	DE87009842	MN -38	12:35375
CONF-8706112-	(11. symposium on ion sources and ion-assisted technology, Tokyo, Japan, 1-3 Jun 1987)				
1	NTIS, PC A02; 3		DE87010377	MN -34A	12:35939
CONF-8706113-	(6. Adriatic international conference on nuclear physics, Dubrovnik, Yugoslavia, 15-19 Jun 1987)				
1	*See* LA-UR-87-1705	E 1.99:	DE87010124	MN -34C	12:36058
CONF-8706118-	(3. international conference on AIDS, Washington, DC, USA, 1-5 Jun 1987)				
1	*See* LA-UR-87-1572	E 1.99:	DE87010112	MN -48	12:35795
CONF-8706123-	(Topical symposium on recent developments in ceramic science, Albuquerque, NM, USA, 17-18 Jun 1987)				
2	*See* SAND-87-1465C	E 1.99:	DE87010954	MN -25	12:35240
CONF-8706127-	(Plant molecular biology, Copenhagen, Denmark, 10-20 Jun 1987)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011124	MN -48	12:34743
CONF-8706128-	(8. international conference on laser spectroscopy, Are, Sweden, 22-26 Jun 1987)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010913	MN -4	12:35940
CONF-8706131-	(78. annual conference of the Special Libraries Association, Anaheim, CA, USA, 6-11 Jun 1987)				
1	*See* SAND-87-0215C		DE87010512	MN -13	12:36225
CONF-870711-	(Solar '87: 12th national passive solar conference, Portland, OR, USA, 12-16 Jul 1987)				
1	*See* SAND-87-0168C	E 1.99:	DE87006122	MN -63d	12:34765
2	*See* SAND-87-0162C	E 1.99:	DE87005908	MN -63	12:34764
3	*See* SAND-87-1119C	E 1.99:	DE87008929	MN -63	12:34737
4	*See* SERI/TP-254-3157	E 1.99:	DE87001166	MN -59A	12:34775
CONF-870712-	(Numerical methods in laminar and turbulent flow, Montreal, Quebec, Canada, 6-10 Jul 1987)				
2	*See* UCRL-95512	E 1.99:	DE87008493	MN -38	12:35403
CONF-870713-	(28. INMM annual meeting on safeguards: a mature technology, Newport Beach, CA, USA, 12-15 Jul 1987)				
2	*See* SAND-87-0948C		DE87010514	MN -15	12:34708
4	*See* SAND-87-0026C		DE87010745	MN -15	12:34706
5	*See* SAND-87-0025C		DE87010734	MN -15	12:34705
6	*See* SAND-87-1037C	E 1.99:	DE87010777	MN -15	12:34710
7	*See* SAND-86-2949C		DE87010736	MN -15	12:34703
8	*See* SAND-86-2987C		DE87010955	MN -15	12:34704
CONF-870723-	(18. international conference on phenomena in ionized gases, Swansea, UK, 13-17 Jul 1987)				
3	NTIS, PC A02; 3		DE87005327	MN -38	12:35412
CONF-870724-	(24. annual conference on nuclear and space radiation in electronics, Snowmass, CO, USA, 28-31 Jul 1987)				
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004909	MN -38	12:35308
2	*See* SAND-87-7030C	E 1.99:	DE87005065	MN -38	12:35422
3	*See* SAND-87-0300C	E 1.99:	DE87005845	MN -38	12:35418
4	*See* SAND-87-0337C	E 1.99:	DE87005858	MN -38	12:35419
6	*See* SAND-87-0286C	E 1.99:	DE87005848	MN -38	12:35417
7	*See* SAND-87-0285C	E 1.99:	DE87005842	MN -38	12:35416
8	*See* SAND-87-0272C		DE87005883	MN -38	12:35415
10	*See* SAND-87-0205C	E 1.99:	DE87006121	MN -38	12:35414
11	*See* SAND-87-0408C	E 1.99:	DE87006128	MN -38	12:35420
13	*See* SAND-87-0220C		DE87006716	MN -37	12:35523
14	*See* SAND-87-7097C		DE87006894	MN -38	12:35423
15	*See* SAND-87-1004C	E 1.99:	DE87008655	MN -38	12:35421

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CONF-870725-	(22. annual meeting of the Microbeam Analysis Society, Kailua-Kona, HI, USA, 13-17 Jul 1987)				
2	*See* LA-UR-87-255	E 1.99:	DE87005096	MN -38	12:35410
3	*See* Y/DK-543	E 1.99:	DE87006040	MN -38	12:35536
5	*See* SAND-87-0249C	E 1.99:	DE87005880	MN -20c	12:36156
CONF-870742-	(10. IFAC world congress on automatic control, Munich, F.R. Germany, 27-31 Jul 1987)				
1	*See* UCRL-96131		DE87007331	MN -37	12:35534
CONF-870743-	(Carnahan conference on security technology, Atlanta, GA, USA, 15-17 Jul 1987)				
1	*See* SAND-87-0822C	E 1.99:	DE87007772	MN -15	12:34707
2	*See* SAND-86-2912C		DE87007680	MN -15	12:34702
4	*See* UCRL-95782	E 1.99:	DE87009583	MN -15	12:35533
CONF-870758-	(International conference on measurement of soil and plant water status, Logan, UT, USA, 6-10 Jul 1987)				
1	*See* LA-UR-87-1506	E 1.99:	DE87010102	MN -70	12:34654
CONF-870760-	(8. international symposium on organosilicon chemistry, St. Louis, MO, USA, 7-12 Jul 1987)				
1	*See* SAND-87-1341C	E 1.99:	DE87010474	MN -4	12:35239
CONF-870802-	(194. American Chemical Society national meeting, New Orleans, LA, USA, 30 Aug-4 Sep 1987)				
1	*See* SAND-87-0270C	E 1.99:	DE87008523	MN -90a	12:34473
4	*See* SAND-87-0374C	E 1.99:	DE87008505	MN -90d	12:34474
CONF-870815-	(6. International Society for Rock Mechanics congress, Montreal, Canada, 30 Aug-4 Sep 1987)				
1	*See* SAND-86-0876C	E 1.99:	DE87003152	MN -92a	12:34561
CONF-870822-	(American Institute of Chemical Engineers summer national meeting, Minneapolis, MN, USA, 16-19 Aug 1987)				
1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011120	MN -13	12:36191
CONF-870862-	(45. annual meeting of the Electron Microscopy Society of America, Baltimore, MD, USA, 2-7 Aug 1987)				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008776	MN -25	12:35124
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010400	MN -25	12:35196
CONF-870867-	(2. international symposium on rock fragmentation by blasting, Keystone, CO, USA, 23-28 Aug 1987)				
2	*See* SAND-86-2882C		DE87009500	MN -123	12:34571
CU-CS-					
360-87	*See* AD-A-178816/5/XAB				12:36186
DESY-					
86-027	NTIS PC E07; Available from NTIS as TIB/B87-00400			MN -34D	12:35965
86-028	NTIS PC E07; Available from NTIS as TIB/B87-00414			MN -34D	12:35966
DESY-L-Trans-					
309	NTIS PC E07; Available from NTIS as TIB/B86-11051			ND -37	12:35511
311	NTIS PC E07; Available from NTIS as TIB/B87-00250			ND -28	12:35456
316	NTIS PC E07; Available from NTIS as TIB/B87-05872			ND -34D	12:35993
DGMK-					
167-4	NTIS PC E11; Available from NTIS as TIB/B87-05909			ND -131	12:34563
248-03	NTIS PC E09; Available from NTIS as TIB/B86-11071			ND -92a	12:34544
289-06	NTIS PC E14; Available from NTIS as TIB/B87-05911			ND -125	12:34558
DHHS/PUB/NIOSH-					
85-115	*See* PB-87-162855/XAB				12:35732
86-124	*See* PB-87-163101/XAB				12:35803
DOE/AL/21557-					
T12	NTIS, PC A07; 3		DE87009659	MN -62a	12:34781
DOE/AL/24970-					
T1	NTIS, PC A18/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010073	MN -71	12:35811
DOE/BP-					
674	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010351	MN -98E	12:35005
746	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009936	MN -98	12:35006
753	NTIS, PC A03; 3		DE87011164	MN -95	12:35024
756	NTIS, PC A07; 3		DE87011160	MN -11	12:34731
758	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011161	MN -11	12:34732
760	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009938	MN -98	12:35007
796	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011162	MN -11	12:35781
820	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009990	MN -80	12:34822
830	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011163	MN -11	12:35782
DOE/BP/14969-					
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009941	MN -98E	12:34996
4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009942	MN -98E	12:35000
DOE/BP/18508-					
1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008883	MN -11	12:34976
DOE/BP/18945-					
T6	NTIS, PC A06; 3		DE87011165	MN -95f	12:35061
DOE/BP/18946-					
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011167	MN -95f	12:35062

Report Number	Availability Source	File Number		Distribution Category	Abstract Number
DOE/BP/18952-2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009924	MN -11	12:35783
DOE/BP/20733-2	NTIS, PC A04; 3		DE87009922	MN -11	12:34733
DOE/BP/22105-1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009359	MN -97e	12:34729
DOE/BP/25593-2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010348	MN -60	12:34798
DOE/BP/35097-4	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010557	MN -11	12:34734
5	NTIS, PC A07/MF A01; 1		DE87011893	MN -11	12:35784
DOE/BP/61747-2	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009909	MN -11	12:35785
DOE/BP/61982-T1	NTIS, PC A05/MF A01; 1		DE87009903	MN -11	12:34735
DOE/CE/11968-T1	NTIS, PC A03; 3		DE87006398	MN -63	12:34760
DOE/CE/15231-T5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009862	MN -95	12:35063
DOE/CE/15240-T4	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87004321	MN -95d	12:35027
DOE/CE/15270-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010793	MN -48	12:35851
DOE/CE/15278-T3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007164	MN -60	12:34800
DOE/CE/40732-T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011024	MN -95f	12:34997
DOE/CE/63478-T4	NTIS, PC A16; 3		DE87009944	MN -95d	12:35028
DOE/CE/63480-T1	NTIS, PC A06; 3		DE87010230	MN -95d	12:35029
DOE/CH/10140-03-86-4	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007366	STD -70	12:34640
DOE/CH/10252-1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007595	MN -60	12:34801
DOE/CH/10287-1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010801	MN -23	12:35812
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011021	MN -23	12:35813
T2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011020	MN -23	12:35814
DOE/CS/30088-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87007940	MN -63	12:34761
DOE/CS/40378-1	NTIS, PC A06; 3		DE87010949	MN -95f	12:35064
DOE/DP-0042	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011604	MN -70	12:34641
DOE/EIA-0226-87/ 02	NTIS, PC A03/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87010361	MN -98E	12:35008
0226(87/ 03)	NTIS, PC A03/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87010973	MN -98E	12:35009
M022	NTIS, PC A06/MF A01 - GPO; 1 (GPO Dep.)	E 1.99:	DE87011309	MN -98A	12:34514
DOE/EIS-0132-D-Vol.2	NTIS, PC A25/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010644	MN -70A	12:34688
DOE/ER/03230-T6	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87011706	MN -34D	12:35967
DOE/ER/05126-310	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007377	MN -34D	12:35994
DOE/ER/05226-5A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010951	MN -4	12:35309
5B	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011189	MN -4	12:35310
DOE/ER/10191-T1	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005020	MN -94cb	12:34969
DOE/ER/10401-6	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010581	MN -66a	12:35885
DOE/ER/10502-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010658	MN -4	12:35311
DOE/ER/10711-6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010464	MN -32	12:36106
DOE/ER/10755-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011200	MN -4	12:35312
DOE/ER/12074-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009660	MN -11	12:34585
DOE/ER/13065-487	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010233	MN -34D	12:35968
DOE/ER/13069-4	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010660	MN -32	12:36194
DOE/ER/13096-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011201	MN -4	12:35890
DOE/ER/13113-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010089	MN -10	12:35291
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010090	MN -10	12:35292
DOE/ER/13114-T2	NTIS, PC A02; 3		DE87010702	MN -48	12:35788
DOE/ER/13161-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011203	MN -48	12:35798

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DOE/ER/13183-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010861	MN -25	12:35233
DOE/ER/13281-3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010698	MN -4	12:35293
DOE/ER/13369-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010747	MN -48	12:34744
DOE/ER/13440-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010653	MN -34A	12:35941
DOE/ER/13447-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009611	MN -20g	12:36056
DOE/ER/13456-7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008773	MN -34A	12:35942
DOE/ER/13529-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010797	MN -25	12:35313
DOE/ER/13615-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011071	MN -4	12:35314
DOE/ER/13620-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011073	MN -4	12:34745
DOE/ER/25026-5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010572	MN -32	12:36195
7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010820	MN -32	12:36196
DOE/ER/40044-T1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87008722	MN -28	12:35485
DOE/ER/40048-04-P7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011078	MN -34C	12:36107
06-P7	NTIS, PC A03; 3	DE87011079	MN -34C	12:35995
07-P7	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87011077	MN -34C	12:35996
DOE/ER/40125-9	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87010091	MN -34D	12:35969
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009609	MN -34D	12:35997
DOE/ER/40150-16	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008670	MN -34D	12:35970
DOE/ER/40243-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011086	MN -34C	12:35971
DOE/ER/40272-22	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87008767	MN -34D	12:36015
DOE/ER/40297-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87006336	MN -34D	12:35972
DOE/ER/40304-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010366	MN -34C	12:35973
DOE/ER/40315-140	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010864	MN -34C	12:35512
DOE/ER/45055-21	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011072	MN -25	12:35126
DOE/ER/45103-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87010584	MN -25	12:35234
DOE/ER/45155-3	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011089	MN -25	12:35127
DOE/ER/45165-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87011012	MN -25	12:35235
DOE/ER/45213-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008833	MN -25	12:35128
DOE/ER/45257-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010952	MN -25	12:35129
DOE/ER/45260-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010821	MN -25	12:35130
DOE/ER/53205-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010862	MN -34A	12:35943
DOE/ER/53222-93	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87010237	STD -20g	12:36117
DOE/ER/60374-T3	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87010309	MN -11	12:35852
DOE/ER/60389-1	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010947	MN -41	12:35822
DOE/ER/60390-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010699	MN -41	12:36082
DOE/ER/60397-H2	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87010689	STD -11	12:35555
DOE/ER/60411-1	IOP Publishing Ltd., Redcliffe Way, Bristol Way, Bristol BS1 6NX, England	TI87010199		12:35953
DOE/ER/60420-1	John Wiley & Sons, Inc., 605 Third Ave., New York, NY 10158	TI87009263	ND -4	12:36108
DOE/ER/60439-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009702	STD -28	12:35439
DOE/ER/60487-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010822	MN -48	12:35315
DOE/ET/29372-6	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87005418	MN -97b	12:34817
DOE/ET/33006-005	NTIS, PC A06; 3	DE87009308	MN -22	12:35316
DOE/ET/51013-213	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010006	MN -20f	12:35944

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DOE/EV/01671-94	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010008	MN -48	12:35823
DOE/EV/10305-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010678	MN -11	12:35695
DOE/EV/10343-121	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010586	MN -48	12:35792
DOE/FC/10297-2334	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001099	STD -106	12:34482
DOE/FC/10601-2336	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006475	STD -108	12:34459
DOE/FC/10620-2353	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011045	MN -109	12:34460
DOE/FC/10627-2361	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011271	MN -106	12:34510
DOE/FE/60177-2347	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010509	STD -109	12:34572
2349	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010732	STD -123	12:34579
DOE/ID-10167	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87010742	MN -95f	12:35065
10169	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011042	MN -95f	12:35066
10170	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011041	MN -66a	12:34797
DOE/ID/12380-13	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010982	STD -95f	12:35131
DOE/IG-0240	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830		TI87011109	STD -13	12:36178
DOE/JPL-1060-92	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005430	MN -62	12:34767
DOE/LC/11067-2235-Vol.1	NTIS, PC A15/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001039	STD -123	12:34573
DOE/LLW-13Th	NTIS, PC A11; 3		DE87009729	MN -70B	12:34642
DOE/MC/21092-2331	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001096	MN -106	12:35435
DOE/MC/21271-2341	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87006482	STD -109	12:34461
DOE/MC/21389-2345	NTIS, PC A11/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010423	MN -111	12:34812
DOE/MC/21391-2333	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001098	STD -111	12:35431
DOE/MC/22012-2302	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001084	STD -106	12:34462
DOE/MC/22109-2330	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001095	STD -111	12:34463
DOE/MC/23136-2293	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87001079	MN -110	12:35020
DOE/METC-87/ 0244	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE87001004	STD -109	12:34464
87/ 0252	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99:	DE87001033	STD -109	12:34465
87/ 0254	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99:	DE87001055	STD -123	12:34574
DOE/NASA-0343-1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010642	STD -96	12:35104
DOE/NE-0078	NTIS, PC A07/MF A01; 1		DE87004452	STD -80	12:34835
DOE/NE/37959-1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010234	MN -80	12:34847
DOE/NE/44139-16	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011873	STD -70	12:34643
DOE/NV/10322-17	NTIS PC E07/MF $9.95 (GPO Dep.)	E 1.99:	DE87011057	MN -70	12:34644
DOE/OR/00033-T298	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009211	MN -34	12:36197
T311	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87009957	MN -70	12:34645
DOE/OR/21390-13	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010700	MN -61	12:34746
DOE/OR/21400-T306	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010381	MN -11	12:34977
T308	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010715	MN -2	12:35824
DOE/PC/60036-15	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009856	STD -102	12:34466
DOE/PC/60797-15	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010480	MN -105	12:34483
DOE/PC/70808-T1	NTIS, PC A02/MF A01; 1		DE87010860	MN -113	12:35236
DOE/PC/79863-T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010427	MN -105	12:34467
DOE/PC/80517-T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010703	MN -113	12:34455
DOE/PC/80522-T4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011338	MN -102	12:34476
DOE/PC/80526-T7	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87011068	MN -102	12:35317
DOE/PC/80536-T6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011339	MN -113	12:34725

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DOE/PC/81544-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87007378	STD -108	12:34468
DOE/PC/90009-2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010959	MN -108	12:34469
DOE/PC/90255-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010771	MN -112	12:35019
DOE/PC/90911-5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011270	MN -108	12:34470
DOE/PC/90958-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010483	MN -102	12:34507
DOE/PC/91101-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010772	MN -105	12:35587
DOE/PC/91272-T12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011026	MN -102	12:34477
DOE/PETC/TR-87/ 9	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87010710	STD -105	12:35588
DOE/RL/01830-2279	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87001068	STD -106	12:34471
DOE/RW-0147	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011599	MN -70	12:34646
DOE/SF/00515-T75	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008761	MN -28	12:35440
DOE/SR-8002	NTIS, PC A04; 3	DE87010911	MN -41	12:35872
DOE/TIC-11628	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87006788	STD -95d	12:35030
DP-1732	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010561	STD -10	12:34600
1735	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87008556	STD -10	12:34601
1744	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010562	STD -10	12:34602
DP-MS-86-114	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010198	MN -11	12:35779
86-152	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010188	MN -41	12:34869
86-179	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010163	MN -11	12:35729
86-180	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010171	MN -11	12:35877
86-181	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010197	MN -11	12:35878
86-191	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010189	MN -38	12:35366
86-210	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010202	MN -11	12:35713
87-2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010182	MN -4	12:34647
87-25	NTIS, PC A02; 3	DE87010187	MN -11	12:35740
DPST-87-209	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010191	MN -41	12:34870
DRES-SM-1185	*See* AD-A-178949/4/XAB			12:35786
ECTB-110-04	*See* PB-87-163424/XAB			12:35606
116-19B	*See* PB-87-163747/XAB			12:35608
116-166	*See* PB-87-164463/XAB			12:35625
145-18A	*See* PB-87-164414/XAB			12:35623
146-11B	*See* PB-87-164513/XAB			12:35628
146-14B	*See* PB-87-164497/XAB			12:35626
146-15B	*See* PB-87-163887/XAB			12:35610
EGG-2499	*See* NUREG/CR-4866	TI87010249	MN -78	12:34861
10282-1119	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010824	STD -41	12:35741
EGG-M-04587	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009395	MN -41	12:35825
28586	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009403	MN -70B	12:34648
29286	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009412	MN -70B	12:34649
29486	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009396	MN -71	12:34855
EH-13	*See* PB-87-169769/XAB			12:35658
EPA-440/ 1-86/ 025	*See* PB-87-172250/XAB			12:35760
440/ 1-86/ 084	*See* PB-87-172268/XAB			12:35761
450/ 4-85/ 011	*See* PB-87-171195/XAB			12:35662
450/ 4-86/ 012	*See* PB-87-168779/XAB			12:35648
450/ 4-86/ 015	*See* PB-87-166963/XAB			12:35634
450/ 4-86/ 017	*See* PB-87-171179/XAB			12:35661
450/ 5-86/ 001	*See* PB-87-168399/XAB			12:35643
450/ 5-87/ 001A	*See* PB-87-166583/XAB			12:35633
530-SW-85-012	*See* PB-87-163242/XAB			12:35747
540/ 09-87/ 157	*See* PB-87-181376/XAB			12:35860
600/ 4-87/ 001	*See* PB-87-165254/XAB			12:35707
600/ 4-87/ 002	*See* PB-87-168076/XAB			12:35641
600/ 8-87/ 003	*See* PB-87-166203/XAB			12:35756
600/ 8-87/ 009	*See* PB-87-168787/XAB			12:35649
600/ D-87/ 057	*See* PB-87-167755/XAB			12:35559
600/ D-87/ 062	*See* PB-87-180055/XAB			12:35684
600/ D-87/ 074	*See* PB-87-167102/XAB			12:35636
600/ D-87/ 075	*See* PB-87-167094/XAB			12:35708
600/ D-87/ 078	*See* PB-87-166989/XAB			12:35800
600/ D-87/ 081	*See* PB-87-167060/XAB			12:35749
600/ D-87/ 112	*See* PB-87-179321/XAB			12:34814

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600/ J-85/ 481	*See* PB-87-178794/XAB			12:34512
600/ J-86/ 200	*See* PB-87-171088/XAB			12:35856
600/ J-86/ 215	*See* PB-87-169637/XAB			12:35657
600/ J-86/ 220	*See* PB-87-169553/XAB			12:35656
600/ J-86/ 224	*See* PB-87-170411/XAB			12:35659
600/ J-86/ 234	*See* PB-87-166286/XAB			12:35069
600/ J-86/ 237	*See* PB-87-169579/XAB			12:34556
600/ J-86/ 249	*See* PB-87-167136/XAB			12:34659
600/ J-86/ 251	*See* PB-87-170478/XAB			12:35660
600/ J-86/ 260	*See* PB-87-166229/XAB			12:35631
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5214	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920446	ND -114	12:34508
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EPRI-NP-				
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5014	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920227	ND -80	12:34841
5060	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920459	ND -2	12:35368
5174	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87008527	STD -85	12:34612
5184M	Research Reports Center, Box 50490, Palo Alto, CA 94303	TI87920437	ND -80	12:34871
5192	NTIS, PC A04/MF A01 - Research Reports Center, Box 50490, Palo Alto, CA 94303; 1 (GPO Dep.)	E 1.99: DE87010293	MN -78	12:34823
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1441	NTIS, PC A02/MF A01; 1	DE87009034	STD -28	12:35457
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158	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010174	MN -79d	12:36224
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1(85) -Vol.10	Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports, $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes:, $80.00 per tape)	TI85014030	MN -51	12:35905
1(85) -Vol.11	Open-File Services Section, Bldg. 41, MS306, P.O. Box 25046, US Geological Survey, Federal Center, Denver, CO 80225 (Hard copy reports, $349.00 per complete set; request price for individual volumes); US Geological Survey, EROS Data Center, User Services, Sioux Falls, SD 57102 (Magnetic tapes:, $80.00 per tape)	TI85014029	MN -51	12:35906
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87	NTIS PC E14; Available from NTIS as TIB/B86-09965			ND -48	12:35832
89	NTIS PC E09; Available from NTIS as TIB/B87-00406			ND -48	12:35833
91	NTIS PC E07; Available from NTIS as TIB/B87-00430			ND -48	12:35834
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276	*See* LA-10978-M	E 1.99:	DE87009484	STD -15	12:34697
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63	NTIS (US Sales Only), PC A02/MF A01		DE87752184	MN -34B	12:35920
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JPL-PUB-					
85-81p	*See* DOE/JPL-1060-92	E 1.99:	DE87005430	MN -62	12:34767
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85-22224/ 1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010224	MN -11	12:34652
K/TS-					
11-861	NTIS, PC A06; 3		DE87009708	MN -22	12:34589
11-864	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010075	MN -22	12:34590
11-865	NTIS MF A01; 2 (GPO Dep.)	E 1.99:	DE87010965	MN -22	12:34591
11-870	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011074	MN -22	12:34592
11-871	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011075	MN -22	12:34593
11-872	NTIS, PC A22/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010583	MN -22	12:34689
11-873	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010964	MN -22	12:34594
LA-					
10650	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010827	STD -41	12:35854
10741-PR	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009464	STD -48	12:35855
10907	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010828	STD -4	12:34603
10917-MS	NTIS, PC A02/MF A01; 1		DE87009474	STD -28	12:35459
10921	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010829	STD -10	12:34604
10927-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010830	STD -70	12:34653
10957-OBES	NTIS, PC A12/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010831	STD -66b	12:34791
10961-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010832	STD -15	12:34693
10967-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009481	STD -15	12:34694
10969-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009482	STD -15	12:34695
10974-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010833	STD -15	12:34696
10975	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010834	STD -10	12:34605
10978-M	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99:	DE87009484	STD -15	12:34697
10990	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87010770	MN -10	12:34597
11000-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010837	STD -34A	12:35955
11001-MS	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010838	STD -34	12:35956
11010-MS	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99:	DE87011261	MN -45	12:35546
11016-MS	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87010840	STD -32	12:36199
LA-UR-					
86-2775	NTIS, PC A19/MF A01; 1 (GPO Dep.)	E 1.99:	DE87007838	MN -28	12:35442
87-255	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87005096	MN -38	12:35410
87-872	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008985	MN -28	12:35490
87-1150	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008987	MN -32	12:36200

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
87-1156	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87008988	MN -28	12:35491
87-1253	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008994	MN -28	12:35492
87-1256	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008996	MN -66a	12:34794
87-1279	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008999	MN -15	12:34698
87-1376	NTIS, PC A03; 3	DE87009005	MN -41	12:35836
87-1504	NTIS, PC A02; 3	DE87010101	MN -15	12:34699
87-1506	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010102	MN -70	12:34654
87-1517	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010103	MN -34	12:35394
87-1541	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010107	MN -32	12:36201
87-1572	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010112	MN -48	12:35795
87-1576	NTIS, PC A02; 3	DE87010113	MN -15	12:34595
87-1585	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010114	MN -25	12:35142
87-1609	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010115	MN -25	12:35143
87-1705	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010124	MN -34C	12:36058
87-1707	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87010125	MN -34	12:36090
87-1737	NTIS, PC A02; 3	DE87010128	MN -34	12:36091
LBL-				
18698	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010371	MN -95d	12:35031
20457	NTIS, PC A06; 3	DE87011222	MN -25	12:35237
21738	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009170	MN -28	12:35493
22094	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009329	MN -28	12:35460
22143	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008227	MN -28	12:35494
22166	NTIS, PC A02; 3	DE87009157	MN -28	12:35443
22168	NTIS, PC A02; 3	DE87009330	MN -28	12:35444
22191	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009167	MN -28	12:35495
22194	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87009168	MN -28	12:35461
22201	NTIS, PC A02; 3	DE87009624	MN -28	12:35462
22212	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009162	MN -28	12:35463
22214	NTIS, PC A02; 3	DE87009549	MN -28	12:35464
22273	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009547	MN -28	12:35496
22274	NTIS, PC A02; 3	DE87009552	MN -28	12:35497
22275	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009446	MN -28	12:35465
22299	NTIS, PC A02; 3	DE87010286	MN -20a	12:35945
22360	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010280	MN -95	12:35032
22387	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010283	MN -20a	12:36154
22487	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010282	MN -66a	12:34792
22715	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009174	MN -28	12:35445
23028	NTIS, PC A02; 3	DE87008230	MN -34D	12:36021
23038	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009160	MN -34D	12:35998
23108	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009156	MN -34D	12:35999
23148	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87010281	MN -34D	12:36022
23158	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010287	MN -70	12:34655
23257	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009644	MN -34	12:36092
23310	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87010987	MN -25	12:34882
23329	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87010769	MN -4	12:35325
23333	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87010818	MN -25	12:35118
23365	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010257	MN -34C	12:36053
23366	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010095	MN -4	12:35357
23387	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011098	MN -25	12:35526
23388	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87010694	MN -25	12:35326
23488	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011214	MN -4	12:35238
LBL-PUB-				
433-5-87/ 255	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010938	MN -34A	12:36093
LMI-ML-				
534	*See* AD-A-178353/9/XAB			12:34995
LR-				
513(MR) -M	*See* PB-87-167946/XAB			12:35430
562(AP) -M	*See* PB-87-169439/XAB			12:35111
563(PA) -M	*See* PB-87-169405/XAB			12:35653
565(PA) -M	*See* PB-87-169413/XAB			12:35654
578(PA) M	*See* PB-87-169967/XAB			12:35080
580(AP) -M	*See* PB-87-167912/XAB			12:35639
582(AP) -M	*See* PB-87-169447/XAB			12:35655
583(PA) -M	*See* PB-87-167896/XAB			12:35638
584(AP) -M	*See* PB-87-167938/XAB			12:35640
MEI-TR-				
86-25	*See* PB-87-184297/XAB			12:34565
MINTEK-M-				
288	*See* PB-87-173258/XAB			12:34511
MIPR-ARO-				
122-84	*See* AD-A-178760/5/XAB			12:35388
MIT/BNL-				
86-6	*See* BNL-39687	E 1.99: DE87010452	MN -25	12:35123
86-9	*See* BNL-39400	E 1.99: DE87010388	MN -11	12:35564
MIT/LCS/TM-				
318	*See* AD-A-178286/1/XAB			12:36181
320	*See* AD-A-178287/9/XAB			12:36182
MIT/LCS/TR-				
374	*See* AD-A-178403/2/XAB			12:36184
MLM-				
3429(OP)	NTIS, PC A02; 3	DE87009198	MN -70	12:36155
3438(OP)	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010369	MN -16	12:34700

Report Number	Availability Source	File Number	Distribution Category	Abstract Number
MPI-PAE/Exp.El.-				
161	NTIS PC E07; Available from NTIS as TIB/B87-00252		ND -34D	12:35976
168	NTIS PC E07; Available from NTIS as TIB/B87-05915		ND -34D	12:35977
169	NTIS PC E07; Available from NTIS as TIB/B87-05916		ND -34D	12:35978
MRL-TN-				
508	*See* AD-A-178564/1/XAB			12:36185
MS-				
6935A	*See* AD-A-178972/6/XAB			12:35391
7031	*See* AD-A-179036/9/XAB			12:35917
MTI-				
86TR33	*See* DOE/NASA-0343-1	E 1.99: DE87010642	STD -96	12:35104
NASA-CR-				
179570	*See* DOE/NASA-0343-1	E 1.99: DE87010642	STD -96	12:35104
NCAR/CT-				
99	*See* PB-87-163218/XAB			12:35600
NEANDC(J)-				
123/ U	JAERI, Tokaimura, Nakagun, 319-11, Japan	TI87900676	STD -34C	12:36039
NMERI-WA-				
5-10-(SS-5.01)	*See* AD-A-178471/9/XAB			12:34540
NMRDI-				
2-74-4628	NTIS, PC A03/MF A01 - NMRDI-Univ. of New Mexico, 457 Washington, S.E., Albuquerque, NM 87108	DE87900732	MN -59A	12:34772
NOAA-TM-ERL-ARL-				
150	*See* PB-87-164992/XAB			12:35557
NOAA-TM-NMFS-SWFC-				
68	*See* PB-87-173357/XAB			12:34769
NORDITA-				
84/ 10-Prepr.	NTIS (US Sales Only), PC A02/MF A01	DE86701660	MN -34C	12:36059
84/ 14-Prepr.	NTIS (US Sales Only), PC A03/MF A01	DE86701663	MN -34C	12:36060
NORSAR-SCIENTIFIC-				
1-86/ 87	*See* AD-A-178251/5/XAB			12:35884
NOSC/TR-				
1121	*See* AD-A-178305/9/XAB			12:35915
NP-				
7752433	NTIS (US Sales Only), PC A09/MF A01; 1	DE87752433	MN -11	12:35710
7752437	NTIS (US Sales Only), PC A06/MF A01; 1	DE87752437	MN -11	12:34988
7752438	NTIS (US Sales Only), PC A02/MF A01; 1	DE87752438	MN -61E	12:34718
7752439	NTIS (US Sales Only), PC A10/MF A01; 1	DE87752439	MN -95d	12:35033
7752440	NTIS (US Sales Only), PC A06/MF A01; 1	DE87752440	MN -13	12:35891
7770096	NTIS (US Sales Only), PC A07; 3	DE87770096	MN -63	12:34762
7770097	NTIS (US Sales Only), PC A09; 3	DE87770097	MN -38	12:35402
7770098	NTIS (US Sales Only), PC A08; 3	DE87770098	MN -38	12:34564
7770099	NTIS (US Sales Only), PC A07; 3	DE87770099	MN -38	12:35369
7770100	NTIS (US Sales Only), PC A08; 3	DE87770100	MN -4	12:35327
7770101	NTIS (US Sales Only), PC A07; 3	DE87770101	MN -25	12:35370
7770102	NTIS (US Sales Only), PC A11; 3	DE87770102	MN -96	12:35083
7770103	NTIS (US Sales Only), PC A07; 3	DE87770103	MN -96	12:35084
7770104	NTIS (US Sales Only), PC A08; 3	DE87770104	MN -96	12:35085
7770105	NTIS (US Sales Only), PC A10; 3	DE87770105	MN -96	12:35086
7770106	NTIS (US Sales Only), PC A13; 3	DE87770106	MN -11	12:35556
7900728	NTIS MF A01; 2	DE87900728	MN -70	12:34656
7900812	NTIS (US Sales Only), PC A15/MF A01; 1	DE87900812	MN -2	12:36040
NPS-				
72-86-002	*See* AD-A-177981/8/XAB			12:34779
NRL-MR-				
5908	*See* AD-A-178138/4/XAB			12:35113
5911	*See* AD-A-177888/5/XAB			12:35401
5922	*See* AD-A-178998/1/XAB			12:35954
NSWC-TR-				
86-89	*See* AD-A-178[illegible]95 7/XAB			12:35059
NUREG-				
0332	NTIS, PC A04/MF A01 - GPO	TI87900835	MN -41	12:34686
0540-Vol.9-No.3	NTIS, PC A20/MF A01 - GPO	TI87900775	MN -2	12:34831
0750-Vol.24-No.1	NTIS, PC A10/MF A01 - GPO	TI87900893	MN -80	12:34832
0936-Vol.5-No.2	NTIS, PC A08/MF A01 - GPO	TI87900416	MN -80	12:34833
1021-Rev.4	NTIS, PC A09/MF A01 - GPO	TI87900735	MN -80	12:34834
1057-Suppl.5	NTIS, PC A08/MF A01 - GPO	TI87900764	MN -78	12:34883
1244	NTIS, PC A03 - GPO	DE87900643	MN -80	12:34990
NUREG/CR-				
3145-Vol.5	NTIS PC E06/MF A01 - GPO	TI87900772	MN -11	12:35887
4012-Vol.2	NTIS, PC A12/MF A01 - GPO	TI87005449	MN -80	12:34836
4330-Vol.3	NTIS, PC A07/MF A01 - GPO	TI87009815	MN -78	12:34956
4651	NTIS, PC A06/MF A01 - GPO	TI87002199	MN -70	12:34657
4700-Vol.4	NTIS, PC A19/MF AO1 - GPO	TI87010288	MN -78	12:34957
4773	NTIS, PC A03/MF A01 - GPO	TI87010958	MN -15	12:34701
4866	NTIS, PC A05/MF A01 - GPO	TI87010249	MN -78	12:34861
4883	NTIS, PC A05/MF A01 - GPO	TI87010088	MN -80	12:34958
4885	NTIS, PC A13/MF A01 - GPO	TI87010803	MN -11	12:34959
4903-Vol.1	NTIS, PC A15/MF A01 - GPO	TI87900766	MN -80	12:34960
4903-Vol.2	NTIS, PC A09/MF A01 - GPO	TI87900767	MN -80	12:34961

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4938	NTIS, PC A05/MF A01; 1	TI87010733	MN -70B	12:34690
4959	NTIS, PC A04/MF A01 - GPO	TI87010897	MN -41	12:35837
NZERDC-				
121	NTIS (US Sales Only), PC A04/MF A01; 1	DE87900751	MN -59B	12:34773
128	NTIS (US Sales Only), PC A03/MF A01; 1	DE87900756	MN -96	12:35112
136	NTIS (US Sales Only), PC A05/MF A01; 1	DE87900758	MN -60	12:34799
NZERDC-P-				
87	NTIS (US Sales Only), PC A03/MF A01; 1	DE87900747	MN -95d	12:35035
109	NTIS, PC A05/MF A01; 1	DE87900820	MN -13	12:35001
110	NTIS (US Sales Only), PC A05/MF A01; 1	DE87900741	MN -96	12:35087
112	NTIS (US Sales Only), PC A07/MF A01; 1	DE87900739	MN -66d	12:34795
OCS/MMS-				
86/ 0105	*See* PB-87-165114/XAB			12:34557
ORNL-				
6239	*See* AD-A-178083/2/XAB			12:35721
6252	*See* AD-A-178152/5/XAB			12:36226
ORNL/Sub-				
81-7242/ 1	NTIS, PC A13; 3	DE87008546	STD -60	12:34802
85-43397/ 01	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010967	MN -114	12:35198
ORNL/TM-				
9227	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87009782	STD -70B	12:34658
10100	*See* NUREG/CR-4651	TI87002199	MN -70	12:34657
10303	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87009784	STD -86	12:34606
10379	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87011951	MN -101	12:35003
10394	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87008559	MN -10	12:34717
10409	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011947	MN -4	12:35946
10433	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87010149	MN -80	12:34862
ORO-				
5126-310	*See* DOE/ER/05126-310	E 1.99: DE87007377	MN -34D	12:35994
OTA-A-				
289	*See* PB-87-177804/XAB			12:34991
OUP-				
87-01	NTIS (US Sales Only), PC A02/MF A01	DE87752185	MN -34D	12:35979
87-04	NTIS (US Sales Only), PC A02/MF A01	DE87752186	MN -34C	12:36061
87-05	NTIS (US Sales Only), PC A03/MF A01	DE87752188	MN -34D	12:36000
PATENTS-US-	(US: Commissioner of Patents, Washington, DC 20231, USA, $1.50 per copy.)			
4,662,510				12:35380
4,663,093				12:34599
4,663,109				12:36176
4,663,110				12:34598
4,663,111				12:36177
4,663,129				12:35361
4,663,511				12:36217
4,664,488				12:35379
4,664,869				12:35359
4,664,892				12:35360
4,664,944				12:35227
4,665,020				12:35796
4,666,654				12:34963
4,666,676				12:34680
4,666,798				12:35022
4,667,059				12:34754
4,667,097				12:35541
4,667,101				12:35398
4,667,107				12:35517
4,667,161				12:34818
PB-				
87-68696/ XAB	NTIS, PC A06/MF A01			12:35589
87-160479/ XAB	NTIS, PC A04/MF A01			12:35295
87-160685/ XAB	NTIS, PC A05/MF A01			12:35590
87-161162/ XAB	NTIS, PC A04/MF A01			12:34730
87-161238/ XAB	NTIS, PC A08/MF A01			12:35730
87-161253/ XAB	NTIS, PC A03/MF A01			12:35591
87-161261/ XAB	NTIS, PC A03/MF A01			12:35106
87-161279/ XAB	NTIS, PC A07/MF A01			12:35731
87-161287/ XAB	NTIS, PC A02/MF A01			12:35592
87-161295/ XAB	NTIS, PC A03/MF A01			12:35593
87-161402/ XAB	NTIS, PC A13/MF A01			12:35056
87-162848/ XAB	NTIS, PC A02/MF A01			12:35873
87-162855/ XAB	NTIS, PC A07/MF A01			12:35732
87-162863/ XAB	NTIS, PC A03/MF A01			12:35594
87-162871/ XAB	NTIS, PC A04/MF A01			12:35595
87-162889/ XAB	NTIS, PC A03/MF A01			12:34488
87-162905/ XAB	NTIS, PC A04/MF A01			12:35596
87-162913/ XAB	NTIS, PC A05/MF A01			12:34978
87-162954/ XAB	NTIS, PC A02/MF A01			12:35746
87-163101/ XAB	NTIS, PC A03/MF A01			12:35803
87-163119/ XAB	NTIS, PC A02/MF A01			12:35597
87-163127/ XAB	NTIS, PC A02/MF A01			12:35598
87-163135/ XAB	NTIS, PC A02/MF A01			12:34489
87-163150/ XAB	NTIS PC PC E03/MF E01			12:34803
87-163200/ XAB	NTIS, PC A03/MF A01			12:35599
87-163218/ XAB	NTIS, PC A08/MF A01			12:35600

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87-163226/ XAB	NTIS, PC A03/MF A01			12:34490
87-163234/ XAB	NTIS, PC A03/MF A01			12:35601
87-163242/ XAB	NTIS, PC A03/MF A01			12:35747
87-163259/ XAB	NTIS, PC A04/MF A01			12:35602
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87-167805/ XAB	NTIS, PC A02/MF A01			12:34774
87-167896/ XAB	NTIS PC PC E04/MF E04			12:35638
87-167912/ XAB	NTIS PC PC E05/MF E05			12:35639
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87-167946/ XAB	NTIS PC PC E06/MF E06			12:35430
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87-168399/ XAB	NTIS, PC A06/MF A01			12:35643
87-168597/ XAB	NTIS, PC A05/MF A01			12:35057
87-168639/ XAB	NTIS PC PC E04/MF E04			12:34494
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87-168670/ XAB	NTIS, PC A09/MF A01			12:35432
87-168688/ XAB	NTIS, PC A08/MF A01			12:35645
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87-168753/ XAB	NTIS, PC A05/MF A01			12:35647
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87-168803/ XAB	NTIS, PC A09/MF A01			12:35650
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87-169447/ XAB	NTIS PC PC E05/MF E05			12:35655
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87-169975/ XAB	NTIS, PC A06/MF A01			12:34509
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87-170676/ XAB	NTIS PC PC E03/MF E03			12:35935
87-170759/ XAB	NTIS PC PC E03/MF E01			12:35116
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87-171179/ XAB	NTIS, PC A04/MF A01			12:35661
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87-177366/ XAB	NTIS, PC A02/MF A01			12:35858
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87-179008/ XAB	NTIS, PC A08/MF A01			12:34503
87-179073/ XAB	NTIS, PC A02/MF A01			12:35433
87-179321/ XAB	NTIS, PC A03/MF A01			12:34814
87-179511/ XAB	NTIS, PC A04/MF A01			12:35071
87-179545/ XAB	NTIS, PC A05/MF A01			12:35763
87-179727/ XAB	NTIS, PC A02/MF A01			12:35764
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87-179743/ XAB	NTIS, PC A02/MF A01			12:35072
87-179842/ XAB	NTIS, PC A09/MF A01			12:35680
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87-180022/ XAB	NTIS, PC A02/MF A01			12:35682
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87-180501/ XAB	NTIS, PC A04/MF A01			12:35685
87-180550/ XAB	NTIS, PC A07/MF A01			12:35686
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87-184289/ XAB	NTIS, PC A07/MF A01			12:34567
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PFC/RR-				
87-6	*See* DOE/ET/51013-213	E 1.99: DE87010006	MN -20f	12:35944
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116	*See* PB-87-180295/XAB			12.35144
PITHA-				
86/ 09	NTIS PC E14; Available from NTIS as TIB/B87-00399		ND -34D	12:36001
86/ 10	NTIS PC E07; Available from NTIS as TIB/B87-01534		MN -34D	12:36002
PNL-				
5809-Vol.3	*See* NUREG/CR-4330-Vol.3	TI87009815	MN -78	12:34956
5892	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87010612	MN -95d	12:35036
5894	*See* NUREG/CR-4773	TI87010958	MN -15	12:34701
5905	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87010577	MN -95d	12:35037
5981	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011233	MN -85	12:34660
6002	NTIS, PC A23; 3	DE87011105	MN -85	12:34613
6003	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87011699	MN -85	12:34661
6004	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87011106	MN -85	12:34662
6035	NTIS, PC A05/MF A01; 1 (GPO Dep.)	E 1.99: DE87009705	MN -70	12:34663
6083	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87009462	MN -70	12:34664
6100-Pt.4	NTIS, PC A04/MF A01 (GPO Dep.)	E 1.99: DE87010025	MN -48	12:35839
6104	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87008397	MN -85	12:34614
6111	NTIS, PC A10/MF A01; 1 (GPO Dep.)	E 1.99: DE87010613	MN -95d	12:35038
6120	NTIS, PC A10; 3	DE87011613	MN -41	12:35699
6128-Vol.2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87010647	MN -62	12:34768
6163	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010328	MN -41	12:36083
6170	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87011232	MN -70	12:34665
6183	*See* EPRI-NP-5174	E 1.99: DE87008527	STD -85	12:34612
6193	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87010026	STD -80	12:35012
6209	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010637	MN -11	12:35706
6217	*See* NUREG/CR-4938	TI87010733	MN -70B	12:34690
6218	*See* NUREG/CR-4959	TI87010897	MN -41	12:35837
PNL-SA-				
14251	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011150	MN -4	12:35296
14488	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87011149	MN -25	12:35145
14612	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011151	MN -13	12:34992
14672	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010865	MN -61D	12:34723
14814	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011154	MN -97	12:35013
14847	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87011140	MN -66b	12:34796
PNL/SRP-				
6215	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010616	MN -70	12:35358
6225	NTIS, PC A02/MF A01; 2 (GPO Dep.)	E 1.99: DE87010615	MN -70	12:34666
PP-				
87-096	*See* DOE/ER/05126-310	E 1.99: DE87007377	MN -34D	12:35994
PPA-T-				
57	NTIS (US Sales Only), PC A02/MF A01	DE87702405	MN -34C	12:36062
PTB-Me-				
42	NTIS PC E09; Available from NTIS as TIB/B86-10247		ND -34	12:35395
56	NTIS PC E07; Available from NTIS as TIB/B86-10260		ND -34	12:35396
RADC-TR-				
86-125	*See* AD-A-178888/4/XAB			12:35933

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86-094	*See* PB-87-170668/XAB			12:35921
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RCA-PRRL-				
86-CR-4	*See* AD-A-178176/4/XAB			12:35386
REPT-				
5-E-3	*See* PB-87-168670/XAB			12:35432
86-703-131	*See* PB-87-184289/XAB			12:34567
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RFP-				
4117	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87011055	MN -13	12:36179
RHO-HS-SR-				
86-13P	NTIS, PC A08/MF A0; 1 (GPO Dep.)	E 1.99: DE87010398	MN -11	12:35742
RHO-PB-SR-				
10	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87008295	MN -71	12:34667
RHO-RE-EV-				
82-P	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87009304	MN -70	12:34668
RHO-RE-SA-				
170P	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008698	MN -70B	12:34669
177-P	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010666	MN -70B	12:34670
RISO-M-				
2607	NTIS (US Sales Only), PC A04/MF A01	DE87752181	MN -32	12:36202
2614	NTIS (US Sales Only), PC A03/MF A01	DE87752179	MN -4	12:35879
2616	NTIS (US Sales Only), PC A05/MF A01	DE87752178	MN -80	12:34853
2622	NTIS (US Sales Only), PC A02/MF A01	DE87752182	MN -25	12:35200
RISO-R-				
495	NTIS (US Sales Only), PC A06/MF A01	DE87752180	MN -11	12:35704
SAIC-				
87/ 1504	*See* AD-A-178483/4/XAB			12:35025
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SAND-				
83-0070	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87011577	MN -70	12:34671
85-1316	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009490	MN -70	12:35711
85-7115	NTIS, PC A07; 3	DE87011575	MN -70	12:34672
86-0404	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010842	MN -34	12:36094
86-0876C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87003152	MN -92a	12:34561
86-1131	NTIS, PC A05/MF A01 (GPO Dep.)	E 1.99: DE87010524	MN -70	12:35893
86-1135-Vol.4	*See* NUREG/CR-4700-Vol.4	TI87010288	MN -78	12:34957
86-1690	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010525	STD -71	12:35372
86-2085	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87010624	MN -11	12:35894
86-2201	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010527	MN -70	12:34673
86-2226	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87009237	MN -70	12:34674
86-2275	NTIS, PC A09/MF A01; 1 (GPO Dep.)	E 1.99: DE87010528	STD -71	12:35373
86-2311	NTIS, PC A07/MF A01; 1 (GPO Dep.)	E 1.99: DE87008892	MN -70	12:35880
86-2526	NTIS, PC A06/MF A01; 1 (GPO Dep.)	E 1.99: DE87008891	MN -70	12:34675
86-2585C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008521	MN -4	12:36095
86-2751C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87011287	MN -25	12:35201
86-2762C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010039	MN -38	12:35374
86-2803	NTIS, PC A03/MF A01 (GPO Dep.)	E 1.99: DE87010991	MN -70	12:34676
86-2804C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87010684	MN -25	12:35202
86-2882C	NTIS, PC A02; 3	DE87009500	MN -123	12:34571
86-2912C	NTIS, PC A02; 3	DE87007680	MN -15	12:34702
86-2949C	NTIS, PC A02; 3	DE87010736	MN -15	12:34703
86-2987C	NTIS, PC A02; 3	DE87010955	MN -15	12:34704
86-7005	NTIS, PC A08/MF A01; 1 (GPO Dep.)	E 1.99: DE87010989	MN -70	12:34677
86-7011	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010993	MN -70	12:34678
87-0025C	NTIS, PC A02; 3	DE87010734	MN -15	12:34705
87-0026C	NTIS, PC A02; 3	DE87010745	MN -15	12:34706
87-0097	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87006334	MN -63	12:34763
87-0154C	NTIS, PC A02; 3	DE87010037	MN -37	12:35527
87-0162C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87005908	MN -63	12:34764
87-0168C	NTIS MF A01; 2 (GPO Dep.)	E 1.99: DE87006122	MN -63d	12:34765
87-0205C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87006121	MN -38	12:35414
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87-0220C	NTIS, PC A02; 3	DE87006716	MN -37	12:35523
87-0249C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005880	MN -20c	12:36156
87-0270C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008523	MN -90a	12:34473
87-0272C	NTIS, PC A02; 3	DE87005883	MN -38	12:35415
87-0285C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005842	MN -38	12:35416
87-0286C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005848	MN -38	12:35417
87-0300C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005845	MN -38	12:35418
87-0337C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87005858	MN -38	12:35419
87-0374C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87008505	MN -90d	12:34474
87-0408C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99: DE87006128	MN -38	12:35420
87-0531	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87009534	MN -28	12:35466
87-0605	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99: DE87010534	MN -11	12:35743
87-0606	NTIS, PC A06/MF A01; 1	DE87010535	MN -11	12:35744
87-0679	NTIS, PC A04/MF A01; 1 (GPO Dep.)	E 1.99: DE87010994	MN -32	12:36203
87-0716C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99: DE87007679	MN -37	12:35528
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87-1057C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008518	MN -38	12:35146
87-1119C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87008929	MN -63	12:34737
87-1129C	NTIS, PC A02/MF A01 (GPO Dep.)	E 1.99:	DE87009078	MN -41	12:34549
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4088	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008867	MN -28	12:35468
4090	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008865	MN -28	12:35498
4096	NTIS, PC A02/MF A01; 1 (GPO Dep.)	E 1.99:	DE87008871	MN -28	12:35469
4097	NTIS, PC A02; 3		DE87009458	MN -34D	12:35470
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D	Dissertation
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TO Tonga
TR Turkey
TT Trinidad and Tobago
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TZ United Republic of Tanzania

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UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
VE Venezuela
VI Virgin Islands of the United States
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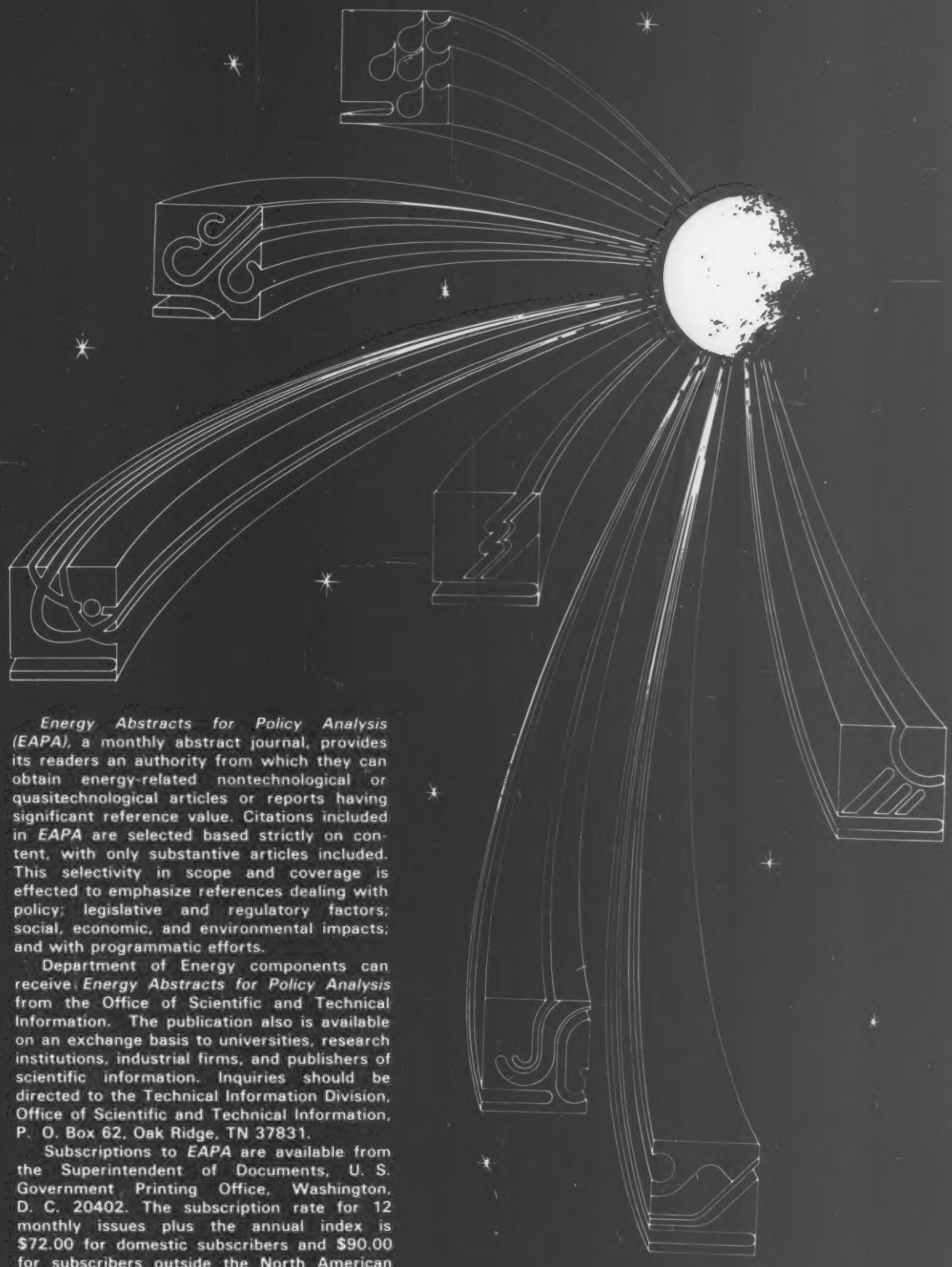

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